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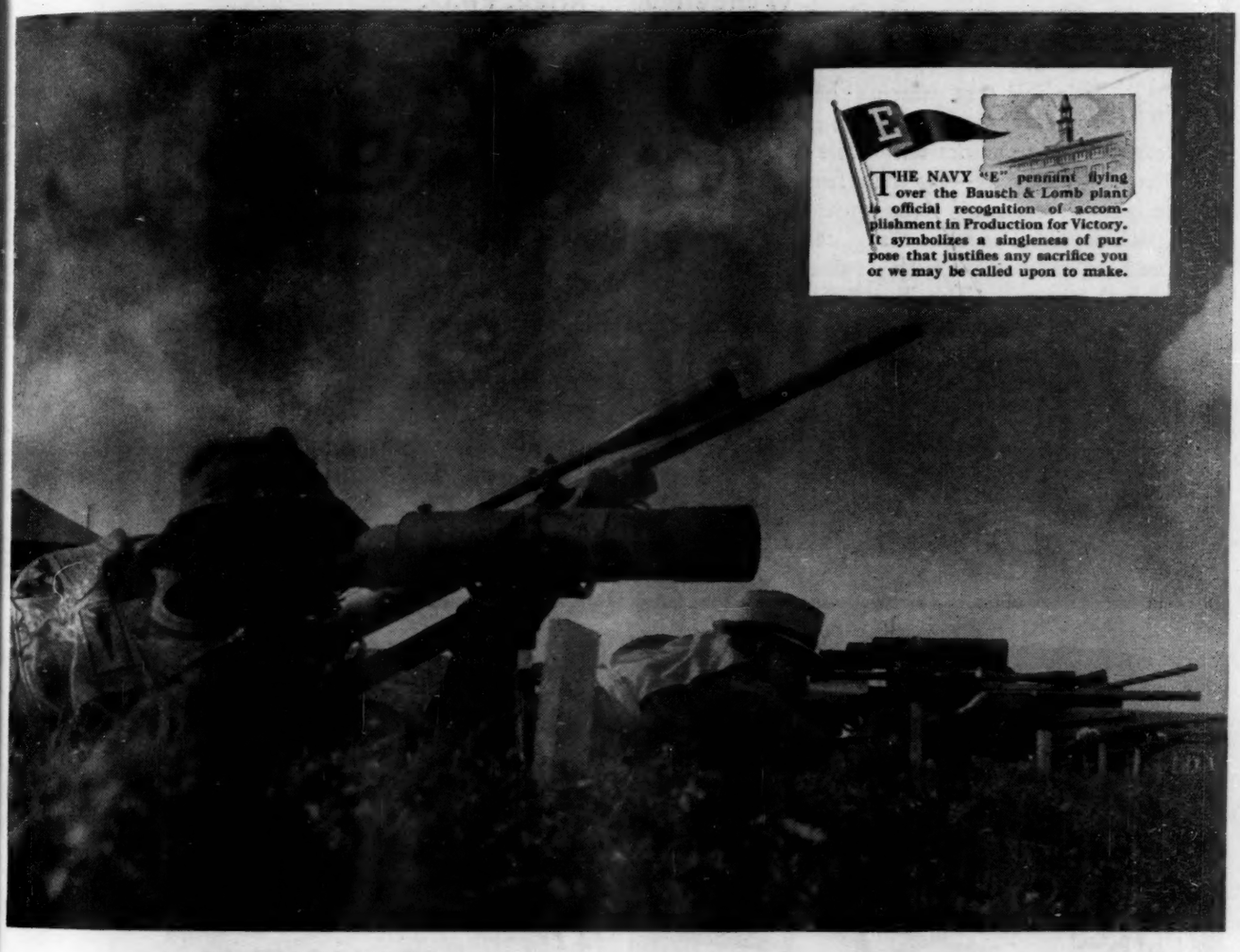
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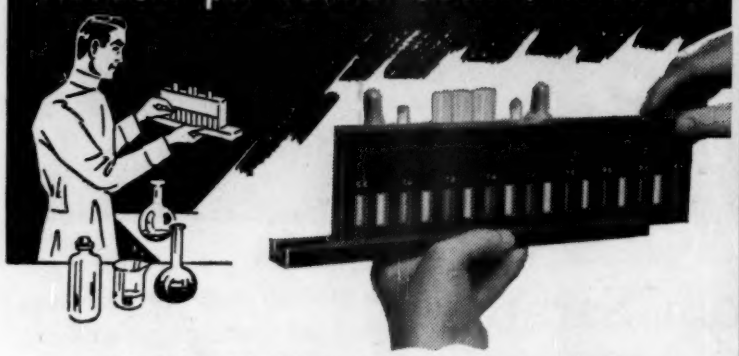

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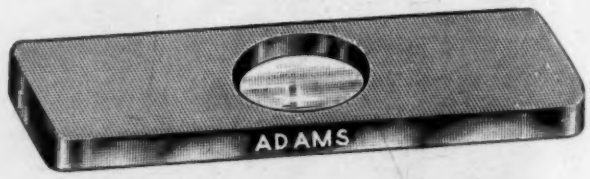

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VOL. 95 FRIDAY, FEBRUARY 20, 1942 No. 2460

Recent Archeological Research in Latin America: DR. WM. DUNCAN STRONG 179
The Problems of Aging and of Vascular Diseases: DR. HENRY S. SIMMS 183
Obituary:
Charles William Lines, Jr. Recent Deaths 186
Scientific Events:
New Haven Industrial Medical Service; Health Services of the Commonwealth Fund; Stalin Prizes; The Inter-America Bureau of the New York Academy of Medicine; The Shortage of Technically-Trained Chemists 187
Scientific Notes and News 189
Discussion:
A Twelve-Month College Year: An All-Out Program: PROFESSOR ALEXANDER SILVERMAN. *Mean Sea Level and Sand Movement—A Reply:* DR. FRANCIS P. SHEPARD and EUGENE C. LAFOND. *On Toad and Frog Abundance After Heavy Rainfall:* DR. ARTHUR N. BRAGG. *Calendar Reform and the National Academy of Sciences:* DR. W. E. CASTLE. *Fisheries Literature for China:* DR. W. F. THOMPSON 192
Special Correspondence:
Analysis of Post-War Problems and Procedures: DR. HUDSON HOAGLAND. *The James River Drainage Area:* PROFESSOR SIDNEY S. NEGUS 195
Scientific Books:
Books on Geology: PROFESSOR KIRTLEY F. MATHER. *Molecular Spectra:* PROFESSOR ROBERT S. MULLIKEN 197
Reports:
Defense Work of the Carnegie Institution of Washington 199
Special Articles:
A Basic Mechanism in the Biological Effects of Temperature, Pressure and Narcotics: DR. FRANK H. JOHNSON, PROFESSOR DUGALD BROWN and PROFESSOR DOUGLAS MARSLAND. *Successful Rearing of a Second Generation of Mice on an Artificial Diet:* DR. LOIS K. ROGERS, DR. L. W. MCELROY and DR. GEORGE R. COWGILL. *Fertile Tetraploids of Sesame, Sesamum Indicum Loew, Induced by Colchicine:* D. G. LANGHAM 200
Scientific Apparatus and Laboratory Methods:
A Model Geyser: DR. J. D. FORRESTER and HOWARD W. THUNE. *Origin of Dipeptidase in a Protozoan:* DR. WM. L. DOYLE and DR. ELIZABETH K. PATTERSON 204
Science News 8

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RECENT ARCHEOLOGICAL RESEARCH IN LATIN AMERICA[1]

By Dr. WM. DUNCAN STRONG

DEPARTMENT OF ANTHROPOLOGY, COLUMBIA UNIVERSITY; MEMBER, INSTITUTE OF ANDEAN RESEARCH

HIGHLY important anthropological research is in progress in Latin America at the present time. Inaugurated prior to the entry of the United States into the war, this work is an aspect of a long-time program of scientific and cultural cooperation between the American republics. These studies include ethnological and sociological research among various highland and lowland communities, physical studies among modern and ancient populations, and, as would be expected in one of the world's richest archeological areas, much exploration and stratigraphic excavation in the ancient ruins. In all Latin America, archeology, ethnology, history and sociology blend into one closely interrelated and fascinating problem of cultural and racial interaction, an understanding of which is as important to the practical statesman as it is challenging to the social scientist.

During the last year the Institute of Andean Research, working under the auspices of the Office of the Coordinator of Inter-American Affairs, has placed ten parties in this vast field working in close cooperation with the scientists of the various Latin American countries. The present program of the Institute of Andean Research—ranging from northwestern Mexico to Chile—aims at completing and publishing on a

[1] Address of the retiring vice-president and chairman for the Section of Anthropology, American Association for the Advancement of Science, Dallas, Texas, December 30, 1941.

series of stratigraphic excavations in certain key areas which will assist in developing a sound and uniform chronology for the major cultures of the New World. Such a temporal framework is essential for any understanding of the interrelationships that existed between the high civilizations of Middle and South America and their influence on native North America. It has, moreover, a direct bearing on many modern historic, geographic and botanical problems of economic and sociological importance. Furthermore, the program as envisaged helps toward an understanding by each country of its own history; it brings a North American personnel of mature scholars and promising graduate students into creative contact with the Middle and South American fields; and by association with scholars in the various countries it provides for intellectual exchange and mutual understanding. Through the employment, where possible, of young regional archeologists it cross-fertilizes the technical disciplines in use and, by the publication of results, provided for in the plan, it makes permanent and available to all the scientific results of the work. There has been in many Latin American countries a very just pride in their Indian past. Such a program as this recognizes that pride and stimulates our own interest in the first colonizers and economic developers of the American continents.

Preliminary to the inauguration of this program Dr. George C. Vaillant, chairman of the Institute of Andean Research, made a rapid survey trip, visiting the various countries where work was proposed. In each he found both sympathetic interest and cordial cooperation which made the arrangement of technical details a mere matter of routine. Subsequent to his report the various field parties began their work, which is now in full progress. Due to this fact it is obviously impossible to give anything approaching a complete summary, but it is believed that a preliminary and partial report may have value at this time. In so doing an attempt will be made to indicate the manner in which these specific projects tend to interdigitate with various national or institutional research programs now in progress in Latin America.

Project 1, in northeastern Mexico, has for its director, Dr. George C. Vaillant, and its supervisor, Dr. Gordon Ekholm. With the full cooperation and assistance of Dr. Alfonso Caso, director of the Institute of Anthropology and History, and his colleagues, Dr. Ekholm is now conducting excavations in the Tampico region. A brief survey of border sites near Laredo, Texas, revealed non-ceramic sites as well as stone-faced, rubble mounds containing pottery and tobacco pipes, some of which were of platform type. In central San Luis Potosi, a more advanced culture than that of the historic Karankawa was investigated at Buena Vista. Here both round and rectangular stone-walled mounds were excavated and various types of painted, incised and negative painted ceramics encountered. The round buildings suggest Huastec types, but the ceramics are different. Preliminary analysis suggests that the latter are related to wares from the early levels at Tajin and to certain types from Teotihuacan. Prior to the peoples of low culture present in this area in historic times, it appears that a sedentary, agricultural people occupied the region, possibly in Late Teotihuacan times, having relationships with both the Tajin and the Tarascan peoples of that period. Subsequent excavations near Tampico revealed plaster-covered conical mounds with stairways, in one case consisting of six superimposed layers. These contained burials accompanied by pottery which shows strong Mixteca-Puebla connections. Excavations in this region are still in progress.

Project 2, in western Mexico, includes Dr. A. L. Kroeber as director, Dr. Carl Sauer as co-director and Dr. Isabel Kelly as supervisor in direct charge of operations. The first portion of Dr. Kelly's work included both surveys and potsherd analyses in Guadalajara. The results of this survey correlate well with native settlement data in historic documents of 1525, and reveal that the majority of sites pertain to a ceramic complex dominated by Autlan Polychrome ware. There are three major ceramic complexes in this region, two date from the time of the Conquest and one is earlier. At the request of the Institute of Anthropology and History work is being carried on for some time in the vicinity of Apatzingan, Michoacan. This is proving interesting but difficult, as sites appear to be rare and material scarce. However, progress has been made in distinguishing the local cultures and toward correlating them with Colima cultures already distinguished in previous work. Further work is planned in the Tuxcacuesco-Sayula zones of Jalisco, where both local and Colima cultures occur and where evidences of aboriginal copper-working have been reported. As in the case of Dr. Ekholm, the work of Dr. Kelly has been fitted into the broad program now being so successfully prosecuted by the anthropologists of Mexico. Like the recent investigations of the National Geographic Society and the Carnegie Institution in the Vera Cruz region, this new work to the west and northeast fits in with the national program of Mexico and tends to link important areas heretofore isolated through lack of scientific exploration.

While much still remains to be done, the Maya area of Yucatan and Guatemala is relatively well outlined, thanks to the work of the Carnegie Institution and other scientific and national agencies. For this reason no projects were proposed here at this time. On the

other hand, San Salvador, one of the most heavily populated Central American countries, and highly important from the archeological standpoint, is little known. Project 10, with Dr. A. V. Kidder as director and John Longyear as supervisor, was therefore located in San Salvador. After preliminary study of national and local collections in this country, Mr. Longyear made an archeological survey of the trans-Lempa river region and, at San Andres in the western part, conducted excavations. Working in conjunction with the Carnegie Institution he has also uncovered deep deposits separated by a volcanic stratum at the great Quelepa site. These excavations promise to throw considerable light on the present obscure sequence of prehistoric cultures in this part of Central America.

To the east, the great Antilles chain extending from Florida to Venezuela likewise tends to link the northern and southern American continents. To extend work already accomplished here, and to specifically attack this problem, Project 5, including Venezuela and the West Indies, was established. Dr. Cornelius Osgood is the director of this project, Dr. Irving Rouse, associate director, with Dr. Carlos Garcia-Robiou as supervisor for Cuba and George Howard for Venezuela. At present Dr. Garcia-Robiou is continuing excavations in Cuba and Mr. Howard is excavating and making further surveys in Venezuela. During the last summer Drs. Osgood and Rouse excavated a number of midden and cave sites and made surveys in both the eastern and the western portions of Cuba. The excavations yielded extensive information on the preceramic Ciboney culture and indicated various culture sequences elsewhere. In Venezuela, Dr. Osgood and Mr. Howard made intensive surveys along the northern coast and up the Orinoco river. Sites were visited in the savannahs of the upper Tigre and Guanipa rivers and the center of a new culture located near the town of Barrancas on the lower Orinoco. Examination of the delta region of the Orinoco gave no indication of sites, which accords with the general nature of the country. Excavations were carried out on the north shore of the Gulf of Paria, and Dr. Osgood also made a survey of the island of Trinidad. Here he discovered archeological evidence which, in his opinion, unquestionably and objectively proves the long-assumed connections between South America and the West Indies. The survey was extended through western Venezuela and work is now in progress in certain sites thus indicated as having particular importance. In this work the cordial cooperation and assistance of the Cuban and Venezuelan governments and scientists, as well as that of various oil companies, has been invaluable.

In South America several projects are operating particularly along the west coast and in the adjacent highland areas. Colombia, the home of the Chibcha and other important higher cultures, is as yet in the stage of regional or geographical surveys as concerns its archeology. Project 6, in Colombia, includes Dr. Wendell Bennett as director and James A. Ford as supervisor. Dr. Gregorio Hernandez de Alba, director of the museum and well known for his work at San Agustin and in the Tierradentro, as well as Dr. Luis Alfonso Sanchez, assistant director of the museum, are both participating in this work in addition to their own researches. Dr. Bennett and Mr. Ford have also received valuable advice and assistance from the famous anthropologist, Dr. Paul Rivet, now director of the Institute of Ethnology in Bogota and formerly head of the Musée de l'Homme in Paris.

Project 6 includes a general survey of Colombia, part of which was accomplished this summer, and intensive excavation in the Cali Region on the middle Cauca River between Quimbaya and the Tierradentro regions. Excavation in this area has already isolated new cultural materials in hollow shaft tombs. From five of these tombs came more than five hundred pottery vessels, two hundred from one tomb alone. Despite such finds, however, lack of large ruins makes location of sites difficult. Refuse deposits appear to be both rare and thin. Ancient house platforms, sometimes faced with rough stone, occur on ridges facing the valleys. Such house platforms range around ten meters in diameter and occur in clusters of as many as three or four hundred. Many olla fragments occur in these sites. Burial tombs are usually made in the outside slopes of house platform. They are usually shafts about one half meter in diameter reaching to a depth of two meters with vaults on the uphill side of the shaft. Larger tombs contain ollas with human bones, but others contain little else than bundle burials of single individuals. The house structures themselves were impermanent, no large ceremonial centers have been noted, and agriculture seems to have been of the temporary or milpas type. Mr. Ford is now engaged in excavation farther east in the mountains. It is hoped that this work as a whole will not only throw light on chronology but may also give some evidence of connections between the high cultures of Central America to the north and those of the Ecuadorian and Peruvian regions to the south. The area is vast and it is obvious that much work must still be accomplished before the work of Preuss, Hernandez de Alba and others around San Agustin can be linked with that of Mason in the Tairona country or with Central America proper.

In Ecuador Project 9B is under the directorship of Dr. Fay-Cooper Cole, with Dr. Donald Collier as supervisor and J. V. Murra as assistant supervisor

conducting the field work. After study of collections and data in Quito, as well as various surveys in which they have been assisted by Ecuadorian students, Dr. Collier and Mr. Murra have moved south in the highland region, where they are finding interesting sites. This project started somewhat later than the others and more detailed reports are not available. Thanks to the pioneer work of Dr. Jijon de Caamaño and a survey now in progress by the School of American Research at Santa Fé under Edwin N. Ferdon, Jr., it has been possible for Dr. Collier and his assistants to secure important guidance in attacking the problem of Ecuadorian culture sequences.

In the north central highlands of Peru another project is operating. This is Project 9A under the directorship of Dr. A. L. Kroeber, with Dr. Theodore McCown as supervisor in charge of field operations. Dr. McCown has received advice and much assistance from various Peruvian archeologists, including Dr. Luis E. Valcarcel, Dr. Julio Tello, Sr., Rafael Larco, as well as many other local authorities. After accomplishing some survey work on the north coast of Peru, Dr. McCown proceeded inland to the famous but little known site of Marca Huamachuco. Here he cleared and mapped a considerable part of the site since the plans made some years ago by Dr. Max Uhle have been lost. Excavation has revealed a variety of architectural types, carved stones and ceramic wares. The entire site appears to be pre-Inca. At last reports Dr. McCown was moving to Viracochapampa, north of Huamachuco, and hoped later to excavate at a previously unexplored site to the east. Ceramic and architectural sequences from this important but little known area should have great importance.

Farther to the south in the Peruvian Highlands, adjacent to Lake Titicaca and Bolivia, Project 7 is in operation. This South Peruvian Highland project has Dr. Alfred Kidder II as director, John Rowe as supervisor and Mrs. Harry Tschopik, Jr., as assistant supervisor. During the past summer Dr. Kidder and his assistants completed a reconnaissance of that portion of the Titicaca basin included in Peru. Many sites, both late and early, were discovered, including burial towers (chulpas), houses and forts. An interesting example of the latter type is the fortress near the temple of Pucara. This structure, referred to in the Inca chronicles, had hitherto been unreported. Numerous sites on the very early Tiahuanaco-Pucara culture level were found, and it is hoped that later excavation may solve the riddle of the temporal relationship of these two important highland cultures. Classification of pottery types, in addition to the surface and stratigraphic surveys, give good promise in this regard. Mr. Rowe, subsequent to visiting sites recently uncovered by the Wenner-Gren Expedition near Machu Pichu, is now engaged in stratigraphic excavations in the vicinity of Cuzco. These should throw light on the development of Inca culture and its relationship to the earlier cultures of the adjacent highland region. This project is closely coordinated with the highland work of such Peruvian scientists as Dr. Luis E. Valcarcel, and others; and indirectly with that of Dr. Arturo Posnansky and his colleagues in Bolivia; and with the long-range ethnic and archeological program of the Peabody Museum of Harvard University.

Regarding the central and southern coasts of Peru, two projects are being undertaken. One of these (Project 8) is under the directorship of Dr. S. K. Lothrop, assisted by Counsellor Dr. Julio Tello, with Dr. Marshall Newman as supervisor. The cultural side of this work includes the preparation and publication of the vast data resulting from Dr. Tello's excavations at the very rich and important site of Paracas. The physical anthropology of the early Necropolis and Cavernas cultures of Paracas is being undertaken by Dr. Newman. In addition, Dr. Newman is cooperating in physical studies of the human materials secured by Project 3, mentioned below. Both the cultural and physical studies under Project 8 are well advanced and the work continues.

The second coastal project in Peru (Project 3) includes Dr. W. D. Strong as director and Gordon Willey as supervisor. Dr. Strong was in the field during the past summer and the work is continuing under Mr. Willey, assisted by John Corbett. Thanks to the unstinted assistance and cooperation of Dr. Tello, Dr. Valcarcel and other Peruvian archeologists, this project has achieved considerable success in intensive stratigraphic excavations in rubbish heaps with the primary purpose of defining ceramic types and sequences. As a result of the invitation of Dr. Tello, who for several years has been intensively excavating at Pachacamac, it was possible for Dr. Strong and Mr. Willey to make a deep stratigraphic cut at this very famous coastal site. This cut, made in a great refuse heap outside one entrance of the Temple of the Sun, revealed two meters of abundant Inca refuse, including other later ceramic styles, while below this were eight meters of deposit containing Interlocking or Proto-Lima pottery and an undescribed negative style. No indubitable Tiahuanaco-Epigonal sherds were encountered, but there is evidence that this intrusive style falls temporally between the Inca and the Interlocking. Thus, to the Inca-Tiahuanaco and Epigonal sequence encountered at this site by Dr. Uhle there is now added a long occupation by a local people who made the Interlocking or Proto-Lima type pottery. The depth of this Pachacamac deposit, some forty feet, and the great abundance of potsherds

from all levels convincingly demonstrates the great possibilities awaiting the refuse heap-potsherd stratigraphic method which, until the present, has rarely or never been successfully employed in Peru. In addition, one small tomb encountered adjacent to this cut yielded nearly one hundred excellent skeletons pertaining to the early Pachacamac-Interlocking period. These were removed by Dr. Newman and will be reported on by him. More recent work by Mr. Willey in the Chancay valley has added to this ceramic sequence. Here, at Cerro de Trinidad, he encountered several meters of consolidated refuse containing Chancay White-on-Red pottery beneath refuse containing Interlocking pottery styles. This was also confirmed by finding a large White-on-Red tomb under undisturbed floors of the Interlocking period. This discovery not only adds an earlier coastal type of ceramics to the Pachacamac sequence but also, on the basis of actual superimposition, reverses Uhle's and Kroeber's conclusions that White-on-Red ceramics were intrusive in Interlocking style tombs and were therefore later. Space is lacking to more than mention excavations already made or in progress yielding incised pottery of Early Ancon (or Coastal Chavin) type. This is the earliest ceramic type yet encountered in the general region and apparently represents a basic and wide-spread Peruvian culture. In certain aspects it approaches a truly Archaic level. Furthermore, certain evidences encountered suggest the presence on the central coast of a pre-ceramic culture, but these are as yet not entirely clear.

In coastal Chile, a pre-ceramic culture has long since been reported by Latcham and Uhle. Recent work by Junius Bird, supervisor of Project 4 (under the same directorship as Project 3), has objectively confirmed this fact and stratigraphically placed the horizon. In the Arica region, Mr. Bird has encountered several stratified sites which run the gamut from hunting peoples of lithic culture to agricultural peoples with pottery, weaving and metals. Not only is direct superimposition present, but it also appears possible to work out many details of development and diffusion regarding horticulture, domestication and technical advance. Work farther to the south in the vicinity of Taltal is now in progress. More detailed results will be reported at a later time.

In conclusion, it must be emphasized that the foregoing is a mere "work in progress" report and stands in need of some correction and much amplification. It is, however, already obvious that detailed stratigraphic excavations in Latin America are yielding rich theoretical results. One thing is certain and that is that there is no lack of stratified refuse deposits on the Peruvian, Chilean and adjacent coasts. It will take time, skill and much hard work to get their full story, but when we do the rich record of ruined city and gorgeous grave find will fall into order and assume cultural meaning within a historical frame. The discoverer of America was not Columbus nor did the European create those great agricultural and economic resources which revolutionized the post-Columbian world. There is much to be learned, both socially and economically, from the past and present achievements of the American Indian, and he would be provincial indeed who regarded such facts as merely academic. Thus, the work continues on a broad front with the close cooperation of North, Central and South American scientists. Its aim is a deeper knowledge and a better application of those vast human and ecologic resources which pertain to the western hemisphere but, in the future as in the past, will actually affect the entire world.

THE PROBLEMS OF AGING AND OF VASCULAR DISEASES[1]

By Dr. HENRY S. SIMMS

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THE PROBLEM OF AGING

THE medical problem of aging is more concerned with prolonging the stamina of youth and middle age than with extending the lives of the aged. It is hoped that we may delay senility rather than prolong it. Although aging has numerous manifestations, such as loss of hair color, of muscular tone and of sex activity, the average individual is most concerned with two manifestations, namely, the progressive loss of physical and mental ability on the one hand and the rapidly increasing death rate with age on the other hand.

The increasing death rate appears to be the only manifestation of aging which, during adult life, shows wide changes that are subject to accurate measurement. A study of the mortality data brings out the great importance of the problem of aging. Human death rate is at a minimum at the age of ten when only one child in 800 dies each year. If the death rate remained at this level throughout the whole life span our life expectancy would be 550 years, instead of 63 years as at present. In reality our death rate

[1] Part of the material in this paper was presented at the Symposium on Aging at the American Chemical Society meetings in Atlantic City, September 9, 1941. The investigation has been aided by grants from W. R. Warner and Company and the John and Mary R. Markle Foundation.

increases 8 per cent. each year throughout the life span until the mortality among elderly people is very high.[2]

In Fig. 1 it may be seen that if in the United States in 1936 there had been only one death in 800 among

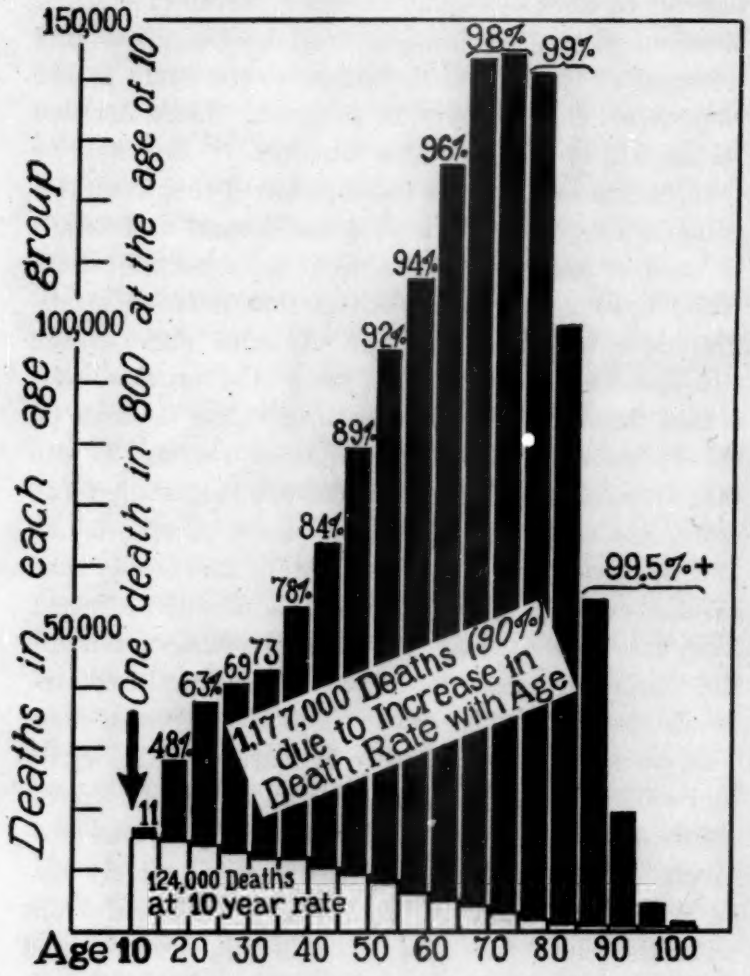

FIG. 1. A comparison of the deaths which occurred in the United States in 1936 with those which would have occurred if the death rate for all age groups had remained at the level found at the age of ten.

people of all ages above ten, there would have been only one tenth as many deaths as actually occurred. These are represented by the white columns at the bottom. The other 90 per cent. of the deaths, *over a million a year in the United States,* result from the increase in death rate with age. Even among people in their early twenties the majority of deaths are due to this increase in death rate with age. Many of these excess deaths may be attributed to the progressive loss of resistance to disease as a result of an underlying aging process.

In accounting for the enormous effect of age on death rate we must distinguish between the "aging process" and the random accumulation of pathological injuries (such as damage from acute infections, from tuberculosis, from silicosis or other industrial hazards, cirrhosis of the liver, nephritis and perhaps arteriosclerosis). Such random injuries should follow a linear relationship with age (except in so far as one injury may accentuate another) and, hence, can not account for the observed increase in death rate[3] which follows a logarithmic equation.[2]

We may therefore conclude that this decreasing resistance to disease is largely the result of *an underlying process of aging which involves the progressive alteration of vital physiological functions.* This "process of aging" may include such progressive changes as those occurring in the blood vessels (including thickening, distension, loss of elasticity or of capillary permeability), diminished vital capacity, changes in metabolism or of water balance or resistance to shock, alteration of endocrine glands and any "wearing out" of tissues or gradual accumulation of metabolic products.

Since loss of physical and mental ability is correlated with diminishing resistance to disease[2] it is to be expected that any amelioration of one manifestation of aging may be reflected in the other.

VASCULAR DISEASES

If we accept aging as our most important medical problem then our second most important problem is vascular diseases. With improved treatment of infections the vascular diseases are becoming increasingly important. In Table I it will be seen that in 1938 in the United States nearly 50 per cent. of the

[2] Henry S. Simms, SCIENCE, 91: 7, 1941. In this paper it is shown that the death rate at age t (for either total deaths or for individual diseases) follows the empirical equation $\log P_t - \log P_o = kt$ where k indicates the rate of aging. Loss of ability follows the same equation.

[3] In so far as one injury may augment another, a logarithmic curve might be obtained; but it is questionable that such a mechanism can account for the 250 fold increase in total deaths between the ages of ten and ninety, or for the 2,000 to 10,000 fold increase in deaths from vascular diseases, without consideration of the aging changes in the blood vessels. Senile debility is correlated with senile mortality and may involve the same mechanism, yet it seems unlikely that progressive physical and mental debility result from accumulated injuries to the various organs rather than from progressive alterations in the circulatory and glandular systems, for example. A few elderly people, while showing no significant pathological damage, become disabled and die within the usual life span. If accumulated injuries were the cause of senile mortality we would expect occasional authentic cases of individuals living to astounding ages such as 150 years, but such is definitely not the case. It was shown by Brody (*Univ. of Mo. Agr. Exp. Sta. Res. Bull.* 105, 1927) that the mortality of drosophila also follows a logarithmic curve similar to that for humans but much steeper. It is difficult to imagine that within the short life span of these insects there is the opportunity for the accumulation of sufficient pathological injuries to produce a many-fold increase in the death rate. Delayed deaths, as in nephritis or cancer, also fail to explain the increased death rate, since the mortality from such diseases involves logarithmic aging curves which are merely displaced along the time axis according to the duration of the disease. Although some of the delayed deaths resulting from rheumatic fever are probably included in the black columns of Fig. 1 these should not account for any predominating portion of the increase in death rate.

TABLE I

RELATIVE IMPORTANCE OF THE VARIOUS PATHOLOGICAL CAUSES OF DEATH AFTER THE AGE OF TEN*
In each disease group, except pregnancy and childbirth, the majority of deaths may be attributed to the loss of resistance to the diseases as a result of aging

Disease or diseased organ	No. deaths	Per cent.
Cardiovascular-renal disease[4] (Heart and arteries 376,907; cerebral hemorrhage 111,073 and chronic nephritis 90,459)	578,439	48.
Infectious diseases (General infectious and parasitic diseases† 96,542; respiratory 75,691; other specified organs 25,739) ...	197,972	16.
Cancer and other tumors	154,551	13.
Accidents and violence	112,405	9.
Digestive system (except infections) ..	50,744	4.
Glands and nutriton	39,137	3.
Genito-urinary system (except chronic nephritis)	27,515	2.
Nervous system (except cerebral hemorrhage and infectious diseases) ..	11,350	1.
Pregnancy and childbirth	9,953	0.8
Blood and blood-forming organs	9,374	0.8
"Senility"	9,242	0.8
Ill defined and miscellaneous	17,713	1.5
	1,218,395	100.

* Rearranged from the United States Vital Statistics for 1938.
† Including 12,728 deaths (1 per cent.) from influenza and 1,952 deaths (0.16 per cent.) from other filterable viruses and rickettsia.

deaths after the age of ten involved diseases of the cardiovascular-renal system.[4] The importance of these diseases is far out of proportion to amount of research being done in this field or to the support received from foundations and research institutions.

Vascular diseases are more prevalent in later life because the death rate from them increases with age more rapidly than from other diseases[2] and because, being chronic, they produce a delayed death.

RESEARCH

Our present knowledge does not warrant a prediction as to the outcome of research on aging and on vascular diseases. There is no justification for the frequent assumption that these are inevitable or that nothing can be done about them. We have as much reason to hope for a retardation in the rate of aging as for a cure for hypertension, cancer, cirrhosis and other diseases which are extensively studied. It can be shown mathematically that whereas the elimination of all remaining infectious diseases would only slightly increase our life span, it would require only a small amelioration of the rate of aging to greatly delay the onset of senility and also extend the life span considerably.

A new method of attack has been developed in this laboratory. Healthy rats in various age groups were killed by a known and measurable cause, namely hemorrhage. The amount of bleeding required to produce death under standard conditions is determined and expressed as "grams of blood per 100 grams of body weight." It was found that 825-day-old rats died with 12 per cent. less hemorrhage than 100-day-old rats. With the aid of a distribution-summation curve these values were converted into probability of death from a given degree of hemorrhage (such as 3.6 per cent. bleeding). The older rats were found to have a probability of death 16 times greater than the younger rats and a plot of the values resembled the curve for spontaneous deaths of rats from disease.

Variations of this technique offer encouraging possibilities for determining the nature of the underlying aging process. Other needed research on aging includes the study of changes in blood vessels, in endocrine function, in metabolism, etc.

FINANCIAL NEEDS

The principal reason for the present neglect of the problems of aging and vascular diseases is not so much the difficulty in their solution as the difficulty in obtaining financial support. Much of the current medical research depends upon grants from the foundations. These foundations restrict themselves mainly to short-term grants, while the problems of aging and vascular diseases can not be adequately investigated by short grants which require quick dramatic results. In discussing grants from foundations, Dr. Alan Gregg, of the Rockefeller Foundation, wisely says,[5] "The good effects . . . are sadly qualified by the continuing preference for short-term grants instead of endowment or long-term support."

The adequate investigation of aging and vascular diseases requires endowments or long-term renewable grants because the study of these problems is handicapped by any demand for quick results. Furthermore, continuous animal colonies are needed to supply old animals and these must be supported for an indefinite number of years. It requires two and a half to three years to raise each old rat or mouse and a laboratory may use $2,500 to $5,000 worth of animals per year.

POSSIBLE SOURCES OF FUNDS

There are several ways in which this situation might be relieved. First, if new foundations are established they might manifest specific interest in aging, or they might adopt the policy of distributing their funds equitably in accordance with the relative importance of the problems without taboo on either long-term grants or on renewals. Second, the existing foundations might alter their policies to meet present needs, as advocated by Dr. Gregg. Third, endowments for

[4] In the "diseases of cardiovascular-renal system" are included arteriosclerosis, coronary diseases, cerebral hemorrhage, chronic nephritis and other diseases of the heart and arteries. This is similar to the grouping used by Dublin, "The Mortality from the Principal Cardiovascular-Renal Diseases," Metropolitan Life Insurance Co., N. Y.

[5] Alan Gregg, "The Furtherance of Medical Research," Yale University Press, New Haven, 1941.

research on aging and vascular diseases might be donated by foundations or by individuals to various medical schools and institutions. An annual income of $50,000 or $100,000 could well be used for this purpose by each medical school. Fourth, federal support is highly desirable, but its present program is quite inadequate. Fifth, popular subscription, which has aided treatment of tuberculosis and poliomyelitis, might yield support for medical research.

Some sources of funds for the study of aging and vascular diseases on a larger scale than is now possible is urgently needed and should be established in the immediate future.

SUMMARY

The increase in death rate with increasing age over that at the age of ten accounts for over a million deaths each year in the United States. To what extent these deaths are due to the aging process remains to be determined, but the progressive loss of resistance to nearly all diseases appears to play a large role even in youth and middle life. Since loss of resistance to disease, as well as loss of ability, seems to result from an underlying aging process we may look upon aging as constituting our greatest medical problem.

Second in importance to the aging problem is that of the vascular and renal diseases, since these are involved in nearly 50 per cent. of the deaths after the age of ten (in addition to the effect of aging).

Until more is known about aging and vascular diseases we are not justified in predicting what can or can not be done about them. A new experimental method in which healthy animals of different ages are killed by a known measurable cause offers possibilities for determining the nature of the aging process.

Our two outstanding medical problems are being neglected largely because of the lack of funds to support both the long-term research and the raising of old animals needed for adequate investigation in this field. New endowments as well as changes in the policies of existing foundations are urgently needed.

Supplementary Note: The war situation which has arisen since this paper was written does not lessen the urgent need for endowments in aid of research on aging and vascular diseases. The deaths from these causes, even among young and middle-aged people, will far exceed the war casualties. Diminished stamina after the age of 40 handicaps both our military and our productive capacity. Hence, continuous colonies of animals should be established immediately in order that old animals will be available for intensive research two or three years from now.

OBITUARY

CHARLES WILLIAM LINES, JR.

September, 1920–January, 1942

CHARLES W. LINES, JR., fellow in botany at the University of Wisconsin, died suddenly on January 9, in Oxford, Miss. (Hospital), as a result of injuries sustained in an automobile accident near there on January 3. He was enroute to Madison, Wisconsin, from Dallas, Texas, where he had attended the Christmas meetings of the American Association for the Advancement of Science as a representative of the Zeta Chapter of Phi Sigma.

He was born in Du Bois, Pa., September 24, 1920. After receiving public-school education at Du Bois, he entered Penn State, where he pursued a varied curriculum, graduating in botanical sciences in 1939. After one semester as a graduate student at Penn State, he went to the University of Wisconsin as a scholar in botany. He was made a fellow in botany for 1941–42.

Among the many accomplishments and endeavors which, despite his chronological youth, were many, his work at the University of Wisconsin was concerned mainly with physiology of fungi, while others, such as wild life conservation, plankton zoology, limnology, ecology, botanical taxonomy and physical chemistry, shared much of his eager interest and time.

He was a member of several scientific and honorary societies, among which were Phi Beta Kappa, Sigma Xi, Phi Sigma and the American Association for the Advancement of Science.

As a scientist Charles Lines was a conscientious, persevering and scholarly person. His future seemed pointed toward unbounded successes and scientific accomplishments. It is sad indeed to have to report the premature termination of such a promising career.

CLASSMATES AND FRIENDS

UNIVERSITY OF WISCONSIN

RECENT DEATHS

DR. ARTHUR MICHAEL, appointed professor of chemistry at Tufts College in 1881; professor of organic chemistry at Harvard University since 1912 and emeritus professor since 1936, died on February 8 in his eighty-ninth year.

DR. LAWRENCE J. HENDERSON, Abbott and James Lawrence professor of chemistry at Harvard University, died on February 10 at the age of sixty-four years.

DR. SAMUEL W. LAMBERT, formerly professor of clinical medicine and dean of the College of Physicians and Surgeons of Columbia University, died on February 9 at the age of eighty-two years.

DR. JACOB ELLSWORTH REIGHARD, professor of zoology at the University of Michigan until his retirement with the title emeritus in 1927, died on February 14 in his eighty-first year. He served for forty-one years on the faculty and for seventeen years as director of the university museums.

DR. WILLIAM DICK CUTTER, secretary of the Council on Medical Education and Hospitals of the American Medical Association since 1931, from 1923 to 1928 dean of the New York Post-Graduate Medical School, died on January 22 at the age of sixty-three years.

ARTHUR HENRY PRATT, consulting civil engineer and chief hydraulic engineer of the Public Service Commission of New York, died on February 1 at the age of sixty-seven years.

MERRILL J. MACK, professor of dairying at the Massachusetts State College, died on February 9. He was thirty-nine years old.

SCIENTIFIC EVENTS

NEW HAVEN INDUSTRIAL MEDICAL SERVICE

NEW HAVEN COUNTY physicians in cooperation with the Department of Preventive Medicine of the Yale School of Medicine have approved the creation of an Industrial Medical Service in factories which do not now have adequate medical service.

Plans have been drawn up for the organization of the service in five plants in New Haven County, each having a personnel of not more than 300 persons. The service will consist of a director, who shall be a physician trained in industrial medicine and is to be responsible for administration and for meeting problems in industrial hygiene, and a nurse trained in industrial medicine. A grant to defray some of the initial expenses has been made by the New Haven Foundation.

"It is estimated that two years will be required to determine whether this service is justifiable and worth continuing or not. At the end of this period the Section of Preventive Medicine of the Yale School of Medicine will review the project. The opinion of the New Haven Medical Association will be solicited at that time."

The functions of the proposed Industrial Medical Service will be:

1. To serve as a demonstration that adequate medical service for small plants is possible.

2. To act in a consultative capacity for those plants in determining the nature of actual or potential hazards (such as the introduction of new factory methods) and to render advice concerning their correction and avoidance. This service is to complement rather than to supplement the service available to industry by the Bureau of Industrial Hygiene of the State Department of Health.

3. To initiate programs of disease prevention in those plants when they seem necessary or advisable. This does not include medical care, which remains in the hands of the family physician.

4. To arrange for pre-employment and periodic physical examinations. These will be given by local physicians.

5. To carry on research problems which have to do with the health of workers in various types of industries and to use the data in an effort to decrease the incidence of disease.

A committee from the New Haven Medical Association will censor the operation of the plan to handle any complaints and any proposed changes. A monthly list of accidents and illnesses in those plants which use the service will be examined by the committee.

HEALTH SERVICES OF THE COMMONWEALTH FUND

THE Commonwealth Fund reported on January 19 that it had appropriated $1,841,332.46 in the year ending September 30, 1941, for purposes associated with "the welfare of mankind," in accordance with the wish of its founder, Mrs. Stephen V. Harkness.

In the past year the fund gave subsidies or consultant services in twenty-eight states in support of four main objectives: the encouragement of research and of good teaching in medical schools; the enrichment and extension of public health services to rural communities; the provision or improvement of hospital facilities and the standardization of hospital services in rural communities; and the strengthening of community facilities for mental health services.

Since most medical research undertakings aided by the fund are of long duration, only three of the thirty-eight pieces of research subsidized during the year were new. These were a clinical statistical review of a series of cases of essential hypertension, at the Columbia-Presbyterian Medical Center; a study of gynecological diagnostic methods, at Cornell University Medical School; and a study of cancer-producing substances from human tissues, at the University of Chicago.

At five schools of medicine departments of preventive medicine were subsidized; special provision was made during the year for the expansion of this department at Tulane. At one school, the University of Louisville, the department of psychiatry was subsidized. At four the fund helped to meet the cost of borderline services designed to link the departments of psychiatry and pediatrics. A grant was made to the Peter Bent Brigham Hospital in Boston to enlarge a psychiatric service forming part of the department of medicine. Seven promising young men

already committed to teaching or research as a career were given fellowships for advanced medical study.

Aid for rural public health services was concentrated in four southern states: Tennessee, Mississippi, Alabama and Oklahoma. In the first of these the fund has been active for seventeen years. In four counties in Tennessee, three in Mississippi and one in Oklahoma local health departments have been built up to a point where they illustrate the value of adequate staffing and a planned program, and, with direct and indirect aid from the fund, the technical and administrative services of the state health departments have been strengthened. The state health laboratory of Oklahoma, for example, did 50 per cent. more work in the first six months of 1941 than in all of 1938. Progress in the control of tuberculosis by artificial pneumothorax and of gonorrhea by sulfonamide therapy marked the work of the county health departments to which the fund gives financial or technical assistance.

No new hospital award was made this year, but a community hospital at Pittsfield, Ill., was completed and one at Mt. Pleasant, Mich., was begun. The capacity of a hospital at Kingsport, Tenn., was doubled, the cost being divided between the fund and the community. The twelve hospitals already in service under this program were used almost to normal working capacity and their earned income rose faster than their operating expenses. At several hospitals visiting instructors from leading medical schools stimulated staff education through long informal clinical institutes.

Mrs. Edward S. Harkness is honorary president of the Commonwealth Fund. Malcolm P. Aldrich is president; the board of directors now includes Mr. Aldrich, Phil W. Bunnell, Samuel H. Fisher, George Welwood Murray, Dean Sage and William E. Stevenson.

STALIN PRIZES

IN 1941, several outstanding Soviet scholars and mathematicians received Stalin Prizes for scientific contributions made during the last six or seven years.

The Stalin Prizes were established in honor of the sixtieth birthday of Joseph Stalin in 1939. They are divided into three classifications: 1st prize, 100,000 rubles; 2nd prize, 50,000 rubles; 3rd prize, 25,000 rubles.

The Soviet mathematicians receiving first prizes were:

Vinogradov, Ivan Metveyevich, member of the Academy of Science of the USSR, for his work published in 1937, entitled "A New Method in the Analytical Theory of Numbers."

Gelvich, Petr. Augustovich, Major General of Artillery, professor of the Artillery Academy of the Red Army, for his scientific works: "On Dispersion, Probability of Hits, and Mathematical Anticipation of the Number of Hits," published in 1934; "Theoretical Fundamentals for the Elaboration of Gunnery Rules," published in 1936; and "Firing at Rapidly Moving Targets," published in 1940.

Kapitza, Peter Leonidovich, member of the Academy of Science of the USSR, for his work "Turbodetander for Obtaining Low Temperatures and Its Application for Obtaining Liquid Air," published in 1939.

Muskhelishvili, Nikolai Ivanovich, member of the Academy of Science of the USSR, professor of the State University in the city of Tbilisi, for his work published in 1935, "Some Basic Problems in the Mathematical Theory of Elasticity."

Mathematicians receiving second prizes were:

Alikhanov, Abram Issaakovich, member correspondent of the Academy of Science of the USSR, and Alikhanian, Artem Issaakovich, scientific worker of the Physico-Technical Institute of the Academy of Science of the USSR, for their scientific work on radio published in 1936, 1938 and 1940.

Kholmogorov, Andrei Nicolayevich, member of the Academy of Science of the USSR, and Khinchin, Alexander Yakovlevich, member correspondent of the Academy of Science of the USSR, professors at the Moscow State University, for their scientific works on the theory of probability: "Asymptotic Laws of the Theory of Probability," published in 1936, "On Analytical Methods in the Theory of Probability," published in 1938, and "Limit Laws of the Sums of Independent Chance Quantities," published in 1938.

Pontriagin, Lev Semenovich, member correspondent of the Academy of Science of the USSR, professor of the Moscow State University, for his work published in 1938, "Topological Groups."

Sobolev, Sergei Ljvovich, member of the Academy of Science of the USSR, professor of the Moscow State University, for his works on the mathematical theory of elasticity: "Some Questions in the Theory of the Expansion of Vibrations," published in 1937, and "On the Theory of Non-Linear Hyperbolic Equations with Partial Derivatives," published in 1939.

THE INTER-AMERICA BUREAU OF THE NEW YORK ACADEMY OF MEDICINE

THE New York Academy of Medicine, realizing the responsibility of North American physicians in the advancement and dissemination of knowledge of the medical sciences in the Western Hemisphere, has organized an Inter-America Division whose purpose is to cultivate friendship, understanding and sympathy with the medical men in other countries of the Americas.

It is pointed out that the present war has dimmed the light of the medical sciences in many, if not all, of

the great medical teaching and research centers of Europe. Even were these centers still operating, access to them by North and South Americans alike is unattainable. As a result, an ever-increasing rapprochement is developing between the scientists of the Western Hemisphere. For the first time, perhaps, many of us are becoming acquainted, exchanging ideas, knowledge and culture.

To further these ends the Bureau of Clinical Information of the academy has made provisions to welcome medical visitors from the American countries and to extend to them the facilities it possesses for the pursuit of knowledge. A Spanish physician who can converse in Spanish, Portuguese and English will be available to the medical visitors from the Republics of Central and South America.

This bureau provides information regarding opportunities for post-graduate medical study in New York or other medical centers of the United States, and particularly publishes a *Daily Bulletin* of clinics, meetings, lectures, conferences, hospital rounds and other interesting medical activities in New York which are freely open to medical visitors.

At the academy itself, many lectures and conferences are held to which visiting physicians are welcomed. The library is one of the largest of its kind in the United States. Its files of American and foreign periodicals are very complete. A bibliographic and photostat service is available for visitors at the usual library rates. The library itself is open to the public every week day from 9 to 5 o'clock.

THE SHORTAGE OF TECHNICALLY TRAINED CHEMISTS

THE American Chemical Society has made public a survey of one hundred and eighteen colleges and twenty-nine chemical corporations and has issued a statement to the effect that present and impending shortages of technically trained men in the army of production threaten to hamper the war effort of the nation.

The survey was conducted by the Defense Committee of the society, consisting of Professor Roger Adams, head of the department of chemistry at the University of Illinois, *chairman;* Dr. James B. Conant, president of Harvard University; Professor Warren K. Lewis, Massachusetts Institute of Technology; Dr. Thomas Midgley, Jr., of Worthington, Ohio, vice-president of the Ethyl Gasoline Corporation; Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh; Dr. Robert E. Wilson, president of Pan American Petroleum and Transport Company, New York; and Dr. Charles L. Parsons, of Washington, D. C., secretary of the society.

It is reported by the committee that many chemical companies complained that production is falling off, and that future production is jeopardized by the withdrawal of trained chemists and chemical engineers from industry. An "appalling shortage" of trained individuals in chemistry and chemical engineering is shown by the colleges, which reported almost without exception that chemical or chemical engineering alumni are all employed and that current demands can not be supplied. Harvard University disclosed that the present shortage of trained chemists is the most serious in its experience.

That essential industry needs in 1942 from 2,000 to 3,000 more chemists and chemical engineers than will be graduated or are otherwise available, and "no one knows whence they are to come," was the situation brought out by a canvass of corporations representing a cross-section of the chemical industry. It is pointed out that "magnesium, aluminum, transparent plastics, rubber, explosives, medicinals and innumerable minor but essential supplies needed by the Army, Navy, Signal, Sanitary and Medical Corps, can be produced only under the guidance of trained engineering and chemical personnel."

The official statement, which is signed by Dr. Charles L. Parsons, secretary of the society, reads:

> The Army and Navy are deeply concerned. Investigations made by this organization prove that trained personnel to produce this material is lacking. Not only the finished product but also the raw material going into smokeless powder, rubber, etc., can be produced only under the active control of experienced chemists and chemical engineers. There is far greater immediate danger to the ultimate outcome of the war from shortages of such man power than there is from any lack of officers and men in the combat force. Without production of essential materials the war will be lost, since the combat forces can not exist without material.

SCIENTIFIC NOTES AND NEWS

THE John Scott Medals and Premiums of the City of Philadelphia were presented on February 13 at the midwinter meeting of the American Philosophical Society to Major Edwin H. Armstrong, professor of electrical engineering at Columbia University, for his work in frequency modulation in radio and to Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories, for his work on thiamin (vitamin B_1).

THE Edison Medal of the American Institute of Electrical Engineers was presented at the annual meeting to Dr. J. B. Whitehead, professor of electrical

engineering at the Johns Hopkins University, and the Alfred Noble Prize for 1940–41 was presented to Robert F. Hays, Jr., of the research laboratories of the Sperry Gyroscope Company, for his paper entitled "Development of the Glow Switch."

THE fiftieth anniversary of the founding of the laboratory of psychology at Columbia University was celebrated at a dinner on February 12. Dr. J. McKeen Cattell, who established the laboratory, was in 1891 called from the University of Pennsylvania, where the first professorship of psychology at any university was held by him. Professor Albert T. Poffenberger presided and addresses were made by President Nicholas Murray Butler, Professor Edward L. Thorndike, Professor Robert S. Woodworth and Dr. Cattell.

AT a special meeting of the Mount Sinai Hospital, a volume was presented to Dr. Bernard Sutro Oppenheimer, in commemoration of his service to the hospital for thirty-seven years. The volume contains 106 papers, filling 869 pages on medical subjects written by specialists as a tribute to his contribution to the study of the heart and circulatory system during his period of service at Mount Sinai.

THE American Social Hygiene Association presented at a luncheon of the society on February 1 an honorary life membership to John D. Rockefeller, Jr., "for outstanding service to the social hygiene movement."

AT the Washington meeting of the Gorgas Memorial Institute of Tropical and Preventive Medicine, Inc., Colonel Joseph F. Siler, of Washington, D. C., was elected president. Other officers elected were: Dr. Bowman C. Crowell, Chicago, *vice-president;* Dr. Merritte W. Ireland, Washington, *secretary,* and A. M. Nevius, Washington, *treasurer.* Dr. Herbert C. Clark is director of the Gorgas Memorial Laboratory in Panama.

MEMBERS of the Institute of Food Technologists, residing in the New York metropolitan area, have organized a local chapter under the name of New York Society of Food Technologists. The officers are: *chairman,* J. H. Shrader; *vice-chairman,* D. K. Maveety; *secretary,* G. L. Montgomery; *treasurer,* R. F. Leight. The association will meet on the first Friday of March, May, October and December, at dinner sessions at the Faculty Club of New York University.

DR. BRADLEY M. DAVIS, professor of botany at the University of Michigan, retires this month with the title emeritus. He will continue to live in Ann Arbor.

DR. MAURICE H. SEEVERS, associate professor of pharmacology at the Medical School of the University of Wisconsin, has been appointed professor of pharmacology and chairman of the department at the Medical School of the University of Michigan.

JOSEPH MARIN, professor of civil engineering at the Illinois Institute of Technology, Chicago, has been appointed professor of engineering mechanics at the Pennsylvania State College. The appointment became effective on February 1.

DR. LOWELL J. REED, professor of biostatistics and dean of the Johns Hopkins University School of Hygiene and Public Health, has been appointed chairman of a national commission on vital records which has been established at the request of the Association of State Health Executives and the American Association of Registration Executives as a special committee of the Health and Medical Committee of the Office of Defense Health and Welfare Services.

HERBERT G. DEIGNAN has been advanced to the position of associate curator in the Division of Birds of the United States National Museum. Dr. David H. Johnson, who has been associated with the Museum of Vertebrate Zoology at the University of California as graduate student and assistant, has been appointed assistant curator in the Division of Mammals.

DR. JOHANNES S. BUCK has resigned his position with Burroughs Wellcome and Company, Tuckahoe, N. Y., to become associate director of the Research Laboratory of the Winthrop Chemical Company, at Rensselaer, N. Y.

ALAN MORRIS, chief metallurgist of the Bridgeport Brass Company, Connecticut, has been appointed director of research.

DR. CHARLES E. OLMSTED, of the department of botany of the University of Chicago, has been made botanical editor of *Ecology.* He succeeds Professor Francis Ramaley, of the University of Colorado. Professor Thomas Park, of the Hull Zoological Laboratory of the University of Chicago, remains editor for zoology.

DR. WILLIAM BEEBE, of the New York Zoological Society, and his associates have sailed for Venezuela. They plan to make a six-months study of conditions in the jungle.

DR. STANHOPE BAYNE-JONES, professor of bacteriology, formerly dean of the Yale School of Medicine, a Lieutenant Colonel in the Reserve Corps, has been called to active duty and assigned to the office of the Surgeon General of the U. S. Army in the Division of Preventive Medicine and Epidemiology. On leave of absence, he will continue as director of the Jane Coffin Childs Memorial Fund for Medical Research, which was established at Yale in 1937 and is primar-

ily concerned with research in cancer. Dr. Ralph G. Meader, assistant professor of anatomy, has been appointed assistant to the director of the fund and will be in charge of the office during the absence of Dr. Bayne-Jones.

THE Board of Pharmacy of the State of New Jersey, with the approval of Governor Edison, has complied with the request of the Civilian Supply Division of the War Production Board to release Dr. Robert P. Fischelis, secretary and chief chemist of the New Jersey Board of Pharmacy and member of the New Jersey State Board of Health, for part-time service as chief of the Section of Medical and Health Supplies of the Civilian Supply Division of the War Production Board. Dr. Fischelis will organize a staff of specialists and consultants in the field of hospital, medical and drug supplies at the Washington office of the War Production Board.

THE president of the Western Society of Soil Science, Dr. Lawrence C. Wheeting, of the State College of Washington, was called to active duty with the United States Army on February 11. Those planning to present papers at the June meeting of the society, which will be held in connection with the meetings of the American Association for the Advancement of Science, Western Division, at Salt Lake City, are requested to communicate with the vice-president, Dr. T. L. Martin, Brigham Young University, Provo, Utah; or with Dr. W. P. Martin, secretary of the University of Arizona, Tucson.

DR. ROGER ADAMS, professor of chemistry, University of Illinois, delivered the fifth Harvey Society Lecture of the current series at the New York Academy of Medicine on February 19. Dr. Adams spoke on "Marijuana."

DR. HARDY CROSS, chairman of the department of civil engineering of Yale University, delivered three addresses at Iowa State College on February 16 and 17. The titles will be "The Column Analogy and Moment Distribution in Relationship to Structural Engineering," "What is Civil Engineering?" and "Epistemology of Engineering." Sponsors for the lectures are, respectively, the Research Council of the college, the Iowa Section of the American Society of Civil Engineers and the chapter of Sigma Xi.

DR. MAURICE C. PINCOFFS, professor of medicine at the School of Medicine and College of Physicians and Surgeons of the University of Maryland, delivered the Henry Sewall Memorial Lecture on February 3 during the annual meeting of the Medical Society of the City and County of Denver. His subject was "Epidural Abscess."

THE Section of Physics and Chemistry of the New York Academy of Sciences will hold on February 27 and 28, at the American Museum of Natural History, a conference on "Physics of the Solid State."

The Journal of Animal Science has been established by the American Society of Animal Production. It will be issued quarterly (February, May, August and November). The journal replaces the Annual Proceedings which have been issued by the society for the past thirty-three years. It will be edited by a board which represents the following branches of work in animal husbandry: Genetics, nutrition, physiology, general livestock, meats, wool, dairy cattle and extension. Ralph W. Phillips is chairman. The business manager of the journal is Dr. A. D. Weber, Kansas State College, Manhattan, Kansas.

THE University of Michigan Extension Service and the Engineering Society of Detroit dedicated on January 28 a new building in the city of Detroit, to be used jointly by the two institutions and to be known as the Rackham Educational Memorial. Funds for the building, which was erected at a cost of $2,000,000, were given to the university and to the engineering society by the Horace H. Rackham and Mary A. Rackham Fund and Mary A. Rackham.

PLANS for the erection of a new radio tube manufacturing plant at Manheim Township, Lancaster, Pa., have been announced by the RCA Manufacturing Company. A tract of land from the Frank McGrann properties adjacent to the Pennsylvania Railroad main line has been purchased by the company. The work, which will be concerned with special purpose radio and electronic tubes, is being undertaken in cooperation with the U. S. Navy. Ground for the main building, which will occupy 326,000 square feet of space, will be broken early in March, and it is expected that the building will be completed by about September 1.

A REPOSITORY for charts and important records of the U. S. Coast and Geodetic Survey is being established as a war-time precautionary measure. The exact location of the repository is not disclosed, but it is understood to be somewhere in the Middle West. An official of the survey was recently detailed to complete arrangements. Discussing this step to protect vitally important nautical and aeronautical charts and other records, Rear Admiral L. O. Colbert, director of the survey, said: "A black and white copy of each of the more than 1,000 nautical and aeronautical charts published by the survey will be sent to the repository. This will enable reproduction by photographic methods in the event that the plates from which they are now printed in the Washington office are lost or damaged. Microfilm copies of valuable seismological records are also being sent to the re-

pository and it is likely that other material of importance will follow."

A SPECIAL fund has been placed in the charge of the Committee on Scientific Research of the American Medical Association to support cardiologic research by young physicians in medical practice. Inquiries may be addressed to the committee, 535 North Dearborn Street, Chicago.

A GRANT of $10,000 has been made by the Carnegie Corporation of New York, in support of the research program of the Clinic of Child Development at the School of Medicine of Yale University. The clinic, which was founded in 1911 by Dr. Arnold Gesell, its present director, is investigating the mental growth of normal infants and devising clinical methods for the early diagnosis of developmental defects and deviations.

A GIFT of £2,000 from the American College of Surgeons has been received by the Royal College of Surgeons of England to help towards its restoration. The gift was offered immediately after the damage by enemy action was described at the recent congress of the American College by Surgeon Rear-Admiral Gordon-Taylor, who attended the congress as the representative of the Royal Navy and the Royal College of Surgeons. The American College has also set aside an additional sum to cover the cost of an appeal to the surgeons of the United States for contributions to a fund to assist still further in the restoration of the English college.

DISCUSSION

A TWELVE-MONTH COLLEGE YEAR: AN ALL-OUT PROGRAM

AFTER World War I, the author published an article, "A Twelve-Month College Year,"[1] in the interest of intensive instruction and the promotion of economy. It is now more important than ever that we follow these principles.

ECONOMIES. UTILITY OF EQUIPMENT AND TIME

We have an enormous investment in schools, colleges and universities, many of which are utilized only seventy-five per cent. of the year. The business world considers efficiency and economy important. Why not use educational facilities the year 'round and operate during the summer months when light and fuel costs are at a minimum?

Some may think that the cost of such a plan would be prohibitive. With present limited endowment incomes and economic resources in education, institutions of higher learning may not be able to operate the entire year. However, with less time loss in education, industry might be so impressed with the service rendered by educational institutions as materially to increase its financial assistance. State legislatures might increase appropriations, and the Federal Government might partially subsidize higher education.

EARLIER EARNING POWER

With a quarter system (four terms of twelve weeks each) students might enter colleges and universities on October 1, January 1, April 1 and July 1. October 1 seems to be the traditional opening date for the college year. Certainly June graduates of high schools would not have to wait until the fall to enter an institution of higher learning. If the quarter system does not appeal, three trimesters of sixteen weeks each can be scheduled. In any event, there are four weeks for vacations out of the fifty-two and these could be distributed in various ways.

Students, instead of losing time during long vacations now in vogue, could obtain a bachelor's degree in twelve quarters or in eight trimesters. What this means in the present emergency has already been stressed by government and by educators. Most college students could obtain their degrees before they are twenty-one. Whether graduates are to serve in industry or are to enter military service, intensive training makes them available at least one year earlier than the traditional system.

STUDENT FINANCES

Not all students could afford to attend college twelve months in a year. Many of them work during summer months to earn enough for tuition. This difficulty could be overcome in a number of ways: (1) With the repetition of courses each quarter or trimester or in alternate quarters or trimesters students who must work to obtain an education could remain out of college for a period during which courses which they have just completed are repeated. Having obtained funds they might take up where they left off. Students could go out at various times of the year and not be dependent on a summer period during which there is a dearth of work and a superabundance of student labor. (2) Establishing a cooperative system would not only help students to finance their education, but it would furnish a regular supply of trained workers for industry and for the nation. Assuming that each undergraduate course is offered each quarter or each trimester, students could be sent out in relays to obtain practical experience in industry, in teaching and in government service. With a definite number

[1] *School and Society*, 12: 291, 80–82, July 24, 1920.

going out each period of the year, industry would have a constant supply and could at the same time appraise desirable individuals who might be employed permanently upon graduating. The government in connection with its ROTC and perhaps similar units for the Navy and aviation could also have students in training, in relays, and be well equipped with a reserve group in time of emergency. The relay system of cooperation with industry is not new. It is in effect in a small number of institutions. The relay system in connection with government service does not exist to the author's knowledge. Certainly if the idea were generally applied, we could continuously afford educational, industrial and Federal fields a supply of individuals for training, and, upon graduation, give the nation a regular supply of skilled leaders. Also, let us not forget that students who can afford to attend college continuously will have their full earning or serving power at the end of two and two thirds or three years in the trimester and quarter systems respectively.

Faculty Salaries and Schedules

At present most teachers are paid only nine or ten months of the year. It is a tradition that the summer period is necessary for study, research or travel. How many teachers utilize the period for any of these purposes? Many of them necessarily work during the summer to increase incomes.

Assuming a twelve-month college year with a regular salary payment for each of the twelve months, the ambitious teacher could still be free during a quarter, trimester or even longer period by making the necessary arrangements and could probably have a much greater variety of study and research at his command than is possible during the summer term. Teachers might even gain practical experience in relays like the students, or they might plan work under great leaders who are not available during summer sessions. By working continuously over an appreciable number of years, an entire year might be available for travel or study. In other words, vacation or study periods could be planned or selected so as best to serve the individual's wants.

What about the traditional summer session? As not all schools are likely to subscribe to a plan like the one which has been proposed, short summer terms to meet state-teacher requirements and the wants of those who have been in the habit of taking summer courses could still be made available.

A Critical Period

A real "all-out" program requires full and immediate cooperation from every man, woman and child. Why not start the "twelve-month college year" now, even if parents and teachers have to make a monetary sacrifice, temporarily? Eventually industry, the state and the nation will make the sacrifice unnecessary.

Alexander Silverman
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MEAN SEA LEVEL AND SAND MOVEMENT; A REPLY[1]

Speculative hypotheses which overlook factual evidence are luxuries which might well be dispensed with during the war, particularly where conclusions might lead to errors of judgment in military construction. A serious case of this nature appeared recently in this journal[2] and was the less excusable because its writer had been informed of the facts. In this article Leypoldt attempted to show that observations by U. S. Grant and by the writers relative to seasonal offshore shifting of sand in winter and onshore shift in summer have been based on erroneous interpretations, and that actually the sand is shifted along the shores of bays due to changing currents piling up at one end of each bay during one season and at the other end during another season. Leypoldt gives the impression that these shifts of the sand are well known and that the out- and in-movement of sand is nothing but an unwarranted assumption.

These arbitrary statements by Leypoldt will be a surprise to every one who has studied the California beaches either from a scientific or engineering point of view. According to Leypoldt, the sand beaches should be as wide on the average in summer as in winter, but the wide zones should be present at different places. This can be said to be absolutely contrary to fact. The writers have made over 50,000 soundings and observations on the width of beaches at La Jolla and elsewhere along the California coast during the past nine years. Short-interval observations have been made for the past four years along the entire length of the beach south of the Scripps Institution of Oceanography at La Jolla and for over a year LaFond has measured the depths along the three open ocean piers in the San Diego area at frequent intervals. Grant and his students have made seasonal measurements of beach profiles at a number of places along the coast near Los Angeles. Also the Los Angeles County engineers have measured profiles off the beaches in Santa Monica Bay at different seasons. The results have been remarkably similar. In nearly all cases the sand level has shown a decrease along the shore during winter and an increase outside. Numerous small beaches in coves of rocky headlands are completely washed out during the first winter storms and do not return until there has been a long

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 155.

[2] Harry Leypoldt, Science, 94: 2452, 607–609, 1941.

period of small waves. In some cases the beach is removed and rebuilt several times during a season, provided there are long calm periods alternating between storms.

On the other hand, there is much evidence of temporary shifting of sand along the beaches and there are times when cutting at one part of a beach is accompanied by fill along another portion. The records obtained from the beach extending south of Scripps Institution show cases of this nature and the observation of currents at the end of the pier show the reason for the shift of the sand. However, these lateral shifts are on the whole subordinate to the outward and inward movements of the sand as evident from the shoaling and deepening of water recorded several hundred feet from shore.

Leypoldt appears to be disturbed by the idea that oscillating wave motions are accompanied by shifting of sand both toward the land and toward the sea. The study of rip currents[3] gave some data in this regard. Also the study of the effects of different kinds of waves[4] in relation to the shifting revealed that large waves of long period shift sand seaward most effectively, whereas small waves of small amplitude shift sand towards the land.

Leypoldt's hypotheses as to the cause of seasonal fluctuation in sea-level heights are as ungrounded as are those concerning sand movements. He states, "Sea-level heights are functions of rainfall in the locality, together with river discharge and other methods of ground-water return, and water removal for rainfall." Observations from the tide staff at La Jolla show that sea level here is usually highest during the months of least rainfall, when the Southern California rivers are dry, and when the water has its highest salinity. The more plausible explanation of sea-level fluctuation is based upon the fluctuations in water temperatures.[5]

Other statements by Leypoldt, such as "When sea level is high along the Pacific coast of the United States it is low along the South American coast, necessitating an interchange of water between the hemispheres," are made without giving any data whatsoever, so that one wonders if they are not also based on some of Leypoldt's hypothetical hunches. It is to be hoped that in the future Mr. Leypoldt will make some attempt to investigate the facts before he lets these wild ideas loose on the scientific public.

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[3] F. P. Shepard, K. O. Emery and E. C. LaFond, *Jour. Geol.*, 49: 337–369, 1941.

[4] E. C. LaFond, *Proc. 6th Pacific Science Congress*, II: 795–799, 1939.

[5] E. C. LaFond, *Jour. Marine Research*, 2: 1, 17–29, 1939.

ON TOAD AND FROG ABUNDANCE AFTER HEAVY RAINFALL[1]

GUNTER'S observation on the exceptional abundance of young toads after a season of very heavy rain in southern Texas[2] prompts me to record my observations on the same type of phenomenon in Oklahoma during the same year. A total of 29.02 inches of rain was recorded at Norman, Oklahoma, during the first half of 1941, of which 25.22 inches came between April 1 and June 30. There were 12.02 inches in June alone. Comparable amounts were recorded in many other parts of the state. The extensive flooding formed temporary pools which did not completely evaporate in some regions till mid-summer. From early in April till near the end of June, extensive choruses of Amphibian voices could be heard almost any night and often during the day immediately after a rain. There was a greater opportunity for all forms to breed than had occurred here for many years.

The various species reacted differently, however. The flooding produced many more young than usual of: (1) *Bufo cognatus* Say—literally millions emerged from pools from early May to early June; (2) *Pseudacris streckeri* Wright and Wright; (3) *Pseudacris clarkii* Baird—choruses were so heavy as to be deafening at times, hundreds of thousands of young emerged; (4) *Microhyla olivacea* (Hallowell); (5) *Scaphiopus bombifrons* Cope; (6) *S. hurterii* Strecker; and (7) *Rana sphenocephala* (Cope). I could find no evidence that the successful reproduction of the following had been materially increased: (1) *Bufo a. americanus;* (2) *B. w. woodhousii* Girard; (3) *Acris crepitans* Baird; (4) *Hyla v. versicolor* Le Conte; and (5) *Rana catesbeiana* Shaw. All the above pertains to the region of Norman, Cleveland County.

In southeastern Oklahoma, neither *B. a. americanus*, *B. w. fowleri*, *Rana clamitans* Latreille, *R. catesbeiana* nor *R. a. areolata* Baird and Girard reproduced successfully in exceptionally great numbers, but *Pseudacris triseriata* (Wied), *Microhyla olivacea* and *Rana sphenocephala* did so.

It should be recorded also that autoists traveling U. S. Highway 66 between Oklahoma City and central New Mexico reported "thousands of young toads" on the road at night in June. Many similar reports from southwestern Oklahoma lead me to believe that *B. compactilis* was very productive, since this is the toad in that region most likely to frequent roadways in numbers.

The differential reactions of these groups of species is in complete accord with the view that some species are specifically adjusted to a grassland habitat in their breeding activities, whereas others are not. For

[1] Contribution from the Zoological Laboratory of the University of Oklahoma.

[2] *Copeia*, 4: 266, 1941.

a fuller expression of these ideas see the following papers by the author.[3]

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CALENDAR REFORM AND THE NATIONAL ACADEMY OF SCIENCES

MANY persons think that our present calendar has certain defects which could easily be remedied. The chief ones are (1) that a particular day of the month occurs in successive years on a different day of the week, making necessary a wholly new calendar each year, and (2) that the length of the months is not uniform but varies from 28 to 31 days. These two defects make the arrangement of schedules for industry and education difficult and temporary only.

Defect (1) could be remedied in a very simple way. The solar year, as recognized in our present calendar, consists of 365 days, or in leap years of 366 days. Neither period is divisible exactly into 7-day weeks. Fifty-two 7-day weeks make 364 days. If the 365th day is not included in one of these 52 weeks, but is considered an *extra Saturday,* or simply a *Year day,* a holiday, the new year will begin on Sunday always. The 366th day of leap years can be used in a similar way as an *extra Saturday,* or *Leap year day,* a holiday in the middle of the year, without disturbing the occurrence of a particular day of the month always on the same day of the week.

Two different proposals for calendar reform which have been widely discussed in recent years remedy defect (1) in this same simple and sensible way. But they differ in the way they deal with defect (2).

A proposed 13-month calendar would have each month consist of exactly 4 weeks. An objection which has proved fatal to this proposal in popular esteem is that the year would not be divisible by months into quarters and the familiar twelve months would have to be abandoned.

A less radical proposal is known as the World Calendar of twelve months and four equal quarters. This retains the familiar month names but adjusts their lengths so as to make them as nearly equal as possible. Each quarter begins on Sunday and ends on Saturday. It contains 91 days. There are 30 days in each month except the first month of the quarter, which by reason of having a fifth (the initial) Sunday has 31 days. The number of week days is the same in every month, 26.

From a wish to ascertain the opinion of a body of eminent scientists upon the desirability and practicability of the proposed World Cadendar, an informal post-card questionnaire was recently sent to each member of the National Academy of Sciences. Replies were received from 168 members, more than half of the entire membership.

One question was worded, *"Do you consider the adoption of a revised World Calendar of 12 months and equal quarters, as outlined by the World Calendar Association, to be desirable?"* The answers were *"Yes,"* 128 (76 per cent.), *"No,"* 17 (10 per cent.), *"Undecided,"* 23 (14 per cent.).

Another question was worded, *"Would you consider it practicable for the United States to begin the use of such a calendar on January 1, 1945* [which will be a Sunday in our present calendar] *in collaboration with other governments?"*

The answers of the 128 who favor the World Calender were *"Yes,"* 74 (58 per cent.), *"No,"* unless the war ends soon enough, 54 (42 per cent.).

There can accordingly be no doubt about what would happen in calendar reform, if the scientists had their way.

W. E. CASTLE

BERKELEY, CALIF.

FISHERIES LITERATURE FOR CHINA

AN official of the Chinese Government with its capital now at Chungking has asked that there be secured for him whatever fisheries literature is available in order that some start may be made on the rehabilitation of Chinese fisheries after the war.

Such assistance will be a practical and direct way of showing our sympathy with the Chinese. It speaks volumes for their courage and confidence that such preparations should be under way.

He would be more than glad to receive any form of fisheries literature whether it deals with life history, systematics or technology which any reader of this notice may be able to spare for transmittal at such time as communications are re-established.

These should be sent to School of Fisheries, University of Washington, Seattle, Washington, and marked plainly as intended for Ti Chow, Chungking.

W. F. THOMPSON,
Director

SPECIAL CORRESPONDENCE

ANALYSIS OF POST-WAR PROBLEMS AND PROCEDURES

AFTER winning the first World War, the Allies lost the peace because of the inability of statesmen and public opinion to understand the dependence of national security on world order and the dependence of world order upon truly workable international relations. Assuming the defeat of Hitlerism, how may

[3] *Amer. Nat.,* 74: 322, 1940; *Amer. Midl. Nat.,* 24: 306–335, 1940; *Wasmann Collector,* 4: 6, 1940; *Turtox News,* 19: 10, 1941; *Great Basin Nat.,* 2: 109, 1941; and *Turtox News,* 20: 12, 1942.

the mistakes of the last twenty-two years be avoided by the victorious nations? Many groups both in and out of government circles are working on aspects of this problem.

Because of the importance of science and specialized learning for problems of post-war adjustment and the need for representatives of the various disciplines better to understand each other, the American Academy of Arts and Sciences is devoting its regular monthly meetings, November through May, to the subject of "Analysis of Post-War Problems and Procedures." The meetings are held at the Boston house of the academy under the chairmanship of its president, Harlow Shapley. The academy has approximately 800 members elected from a wide variety of professional fields. It especially represents competences in the natural and social sciences and in engineering and affairs.

Alfred North Whitehead, professor emeritus of philosophy, Harvard University, opened the series in November with a paper entitled, "Statesmanship and Specialized Learning."

The meeting on December 10th was concerned with problems of communication and transportation in a post-war world. Igor I. Sikorsky, engineering manager of United Aircraft Manufacturing Corporation, spoke on "The Air Transportation of the Future." Walter S. Lemmon, president of the World Wide Broadcasting Foundation, spoke on "Radio as a New Force in the Post-War World." A forum on December 15th followed this meeting and was led by Douglas H. Schneider, program manager of Station WRUL, and Joseph S. Newell, professor of aeronautical structural engineering at the Massachusetts Institute of Technology.

The meeting on January 14th was addressed by Zechariah Chafee, Jr., Langdell professor of law at Harvard University, on the subject of "International Utopias."

The February meeting will be in the hands of geographers. Professor Clarence Jones, of Clark University, will consider the economic geography of Latin America in relation to the war and to post-war problems, and Professor Samuel Van Valkenburg, also of the Clark geography department, will discuss the significance of the Netherlands East Indies in the present conflict.

At the March meeting anthropologists and social psychologists will consider ways in which these sciences may be of help in implementing the ideals of post-war democracy.

HUDSON HOAGLAND,
Recording Secretary
AMERICAN ACADEMY OF ARTS AND SCIENCES

THE JAMES RIVER DRAINAGE AREA

THERE is now being compiled, under the chairmanship of Dr. Marcellus H. Stow, professor of geology at Washington and Lee University and president-elect of the Virginia Academy of Science, a monograph on the James River drainage area. The river, of so much romantic appeal, thus forms the unifying feature around which will be correlated an imposing body of scientific, sociological and historical research. Of Virginia's 100 counties, forty-two are either wholly or in part within the James River drainage basin. All branches of science are represented within the area and most of the universities, colleges and research institutions of the state are there located.

Dr. Stow will write the editorial preface of the monograph, to be called "The James River—Past, Present, Future," and will also cooperate with Joseph K. Roberts, professor of geology at the University of Virginia, and E. C. H. Lammers, assistant professor of geology at Washington and Lee, in preparing the chapter on "Geology." Other chapters and those who have accepted invitations to write them are as follows: "The James River Region as a Thoroughfare before the Coming of White Men," Austin H. Clark, curator of echinoderms, Smithsonian Institution; "Development of Transportation in the James River Area," L. S. Evans, assistant to vice-president, Chesapeake and Ohio Railway, and John J. Forrer, maintenance engineer, Virginia Department of Highways; "Recreation in the James River Region," Robert F. Nelson, public relations counsel, Virginia State Chamber of Commerce; "Agriculture," A. W. Drinkard, Jr., director, Virginia Agricultural Experiment Station; "Astronomy, Mathematics, Physics," T. McN. Simpson, dean of Randolph-Macon College; "Botany," Ivey F. Lewis, dean of the University of Virginia; "Entomology," G. T. French, entomologist, Virginia Department of Agriculture; "Fish and Marine Invertebrates," Donald Davis, professor of biology, College of William and Mary, C. L. Newcombe, professor of biology, College of William and Mary, and Theodore Fearnow, wildlife technician, U. S. Forest Service; "Reptiles and Amphibians," Paul Burch, professor of biology, Radford State Teachers College, and Robert P. Carroll, associate professor of biology, Virginia Military Institute; "Birds," James J. Murray, Lexington; "Mammals," Talbott E. Clarke, wildlife technician, U. S. Forest Service; "Inorganic Chemistry," William G. Guy, professor of chemistry, College of William and Mary; "Education and Psychology," Dabney S. Lancaster, state superintendent of public instruction; "Engineering," Carter Hanes, associate professor of engineering, Virginia Military Institute; "Forestry," Chapin Jones, professor of forestry, Uni-

versity of Virginia; "Medical Sciences," H. J. Warthen, Richmond; "Industry in the James River Area," L. S. Evans, assistant to vice-president, Chesapeake and Ohio Railway; and "Conservation of Natural Resources," Henry B. Ward, emeritus professor of zoology, University of Illinois. The chapter on "Organic Chemistry" has not yet been assigned.

The monograph, to be approximately 600 pages, is expected to be published by the Virginia Academy of Science by the fall of 1942. Obviously it will be an incomplete work, but it should call attention to needed fields of investigation in the region and thereby serve as a stimulus for a serious long-term statewide undertaking to which scientists and others of various interests can contribute. It might also prove to be an example of what might be done elsewhere.

SIDNEY S. NEGUS
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SCIENTIFIC BOOKS

BOOKS ON GEOLOGY

NEW EDITIONS OF STANDARD TEXTS

Outlines of Physical Geology. By CHESTER R. LONGWELL, ADOLPH KNOPF and RICHARD F. FLINT. Second edition. 381 + ix pages. 281 figs. + frontispiece. John Wiley and Sons. 1941. $2.75.

Outlines of Historical Geology. By CHARLES SCHUCHERT and CARL O. DUNBAR. Fourth edition. 291 + ix pages. 176 figs., 6 plates + frontispiece. John Wiley and Sons. 1941. $2.50.

Outlines of Geology. By LONGWELL, KNOPF, FLINT, SCHUCHERT and DUNBAR. Second edition. A combination of the two preceding books, bound into a single volume. John Wiley and Sons. 1941. $4.00.

Introduction to Geology. By E. B. BRANSON and W. A. TARR. Second edition. 482 + ix pages. 447 figs. McGraw-Hill Book Company. 1941. $3.75.

Introduction to Physical Geology. By WILLIAM J. MILLER. Fourth edition. 465 + xi pages. 397 figs. + frontispiece. D. Van Nostrand Company. 1941. $3.25.

Field Geology. By FREDERIC H. LAHEE. Fourth edition. 851 + xxxii pages. 589 figs., 1 plate. McGraw-Hill Book Company. 1941. $5.00.

HERE is abundant evidence of the vitality of geological science and the eagerness of textbook writers in this field to provide the student and field worker with the best possible tools for their work. Advances in method and doctrine, chiefly the result of emphasis upon quantitative as contrasted with qualitative analysis of geological problems, have been numerous in the last few years and many of the repercussions of this progress are reflected in these new editions of standard treatises. Improved pedagogical techniques are also apparent, as well as a considerable improvement in illustrative material, involving both the frequent use of aerial photographs and more skilful drafting of block diagrams and other line drawings.

The "Outlines" of physical and historical geology, by the Yale geologists and paleontologists, contain many significant changes from the preceding editions published respectively seven and four years ago. As they now stand they are even better suited than before to meet the needs of the interested layman who wants an introduction to earth science without formal instruction, and at the same time they will serve even more satisfactorily as textbooks for elementary courses on the college level. The number of technical terms has been reduced to what is now in all probability the irreducible minimum. Considerable attention is paid to the numerous practical aspects of geology, including its application in engineering projects such as dams, aqueducts and tunnels. In presenting the history of the earth and its inhabitants, eras rather than periods are used as the units for treatment, and the record of changes in the physical features of the earth is presented in its entirety before the pageant of life is considered.

The "Branson and Tarr" has similarly been streamlined by simplification of treatment and terms so that the new edition is even more suitable than the old for instruction of students who do not plan to become geologists, while at the same time it will serve admirably as the basis for the first steps in the training of professional workers in the field of earth science. Improvements in the illustrations are especially notable, both because of additions and substitutions and as a result of better paper and printing.

In comparison with the earlier third edition of Miller's textbook, the fourth edition, now in hand, embodies numerous minor changes, but the general style and method of treatment remain the same. Many improvements in the illustrations are apparent and the statistical material pertaining to economic geology has been brought up to date.

The new edition of Lahee's widely used manual, when compared with the earlier edition published in 1931, provides a very accurate measure of the progress of geology during the decade. New material on such subjects as mass movements, varves, lensing strata, permeability of sedimentary rocks, petrofabrics, electrical logging, subsurface correlation by radioactivity

and airplane mapping, reflects the results of intensive research in field and laboratory and the increased use of various geophysical methods for geologic exploration. The wealth of excellent diagrams and photographs, the systematic organization of the text, and the concise, lucid style make this book an unusually valuable tool for the professional geologist as well as a very effective text for the student.

Earth Sciences. By J. HARLEN BRETZ. 260 + x pages. 129 figures. John Wiley and Sons. 1940. $1.75.

THIS compact book is one of a series edited by Dr. Gerald Wendt comprising material for a survey course for college students covering the natural sciences. Its author is professor of geology in the University of Chicago, where he has had an unusual opportunity to experiment along the lines of presenting science as an integral part of a liberal education rather than merely as preparation for a professional career. Its subject-matter is that of the three closely related fields of meteorology, oceanography and geology, the sciences that deal with the various natural elements in our physical environment.

Dr. Bretz has selected his topics and discussed them with his readers with rare skill, successfully avoiding a superficial smattering of descriptive knowledge on the one hand and a merely verbal lightening of the burden of technicalities on the other. The chatty informality of his style makes "easy reading." The well-phrased and often sharply pointed questions, sifted throughout the pages as footnotes or in the body of the text, must stimulate even sluggish minds and are well designed to keep the reader intellectually alert. Most important of all, however, is the artistry with which he lays the groundwork for an appreciation of the method of scientific approach and of its trustworthiness.

Outlines of Structural Geology. By E. SHERBON HILLS. 172 + x pages. 105 figures, 4 plates. Nordeman Publishing Company. New York. 1940. $2.25.

THE concisely written text and expertly selected diagrams of this slender volume combine to make it a most valuable tool for both the student of structural geology and the well-trained worker in this field. The numerous definitions of terms and the rather full synonymy are especially helpful because of the various usages regarding nomenclature in the description of many types of geologic structure. Many a geologist will value it as a reference work to be kept close at hand while compiling reports and preparing papers for publication.

Dr. Hills is lecturer in geology in the University of Melbourne. He has read widely and draws his illustrations from North American geology as often as from that of Europe. He makes good use of many geophysical data available from research in high-pressure laboratories in the United States as late as 1939. The handicap resulting from the geographical remoteness of Australia has been completely overcome.

Beginning with a survey of primary structures of sedimentary rocks and non-diastrophic deformation, Dr. Hills proceeds with a consideration of the mechanical principles of rock deformation. The next chapter deals with the major structural features of the earth's crust and then come chapters on folds and faults. Finally, after a survey of the structures of igneous rocks in which the work of Cloos and his collaborators is stressed, there is a brief but inclusive chapter on petrofabric analysis.

Geology of Coal. By OTTO STUTZER. Translated and revised by Adolph C. Noé. 461 + xiii pages. 198 figures. University of Chicago Press. 1940. $5.00.

THIS is much more than a mere rendering into English of a classic monograph in German. Dr. Stutzer's "Kohle," published in 1914, served as the nucleus of the material translated by Professor Noé, but considerable portions of the book are translations of texts supplied subsequently by Dr. Stutzer or of material published more recently by him. To this is added a modicum of original matter based on Professor Noé's own studies under the auspices of the geological surveys of Illinois and Kentucky and as geologist of the Allen and Garcia Commission to Soviet Russia, as well as his research as professor of paleobotany at the University of Chicago. In the preparation of the book for publication after Professor Noé's death, Dr. Gilbert H. Cady, of the Illinois Geological Survey, rendered valuable service.

The book deals extensively with the nature of coal, its mode of formation, its peculiarities of variation, the thickness and extent of coal beds, the nature of the associated rocks, the character of irregularities of various sorts that affect the ease of recovery of coal in mining operations, the methods of study by means of thin sections and chemical analysis, and the floras associated with coal of various localities and ages. It includes little data pertaining to statistics of coal resources, production or reserves.

Students in university courses dealing with the geology of fuels will find this a most helpful text. Geologists, mining engineers and other persons concerned with the coal industry will gain much valuable information from it and will find its extensive bibliographies particularly useful.

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MOLECULAR SPECTRA

The Identification of Molecular Spectra. By R. W. B. PEARSE and A. G. GAYDON. 221 + viii pp., 8 plates. New York: John Wiley and Sons, Inc. 1941. $8.00.

THE essential features of this book are (1) a "Table of Persistent Band Heads" arranged in order of wave-length, (2) a compilation entitled "Individual Band Systems" containing rather complete lists of band heads arranged according to molecules. In addition there are very helpful brief discussions on the purpose and method of use of the tables and on the spectroscopic sources from which band spectra are obtained. There are a useful appendix and an excellent set of plates showing reproductions of important band spectra. The book fills an important gap for research workers in the field of molecular spectra, who hitherto have had no systematic guide for the rapid identification of known bands. It may also help to make possible the use of band spectra in spectrochemical analysis.

The tables cover the range λ2,000–10,000. The attempt has been made to include all diatomic spectra and some of the simpler polyatomic spectra, but spectra of solutions, liquids and solids are excluded. In the Table of Persistent Heads, bands "of particularly frequent occurrence as impurities" are marked with asterisks. Here one might disagree somewhat with the assignment of asterisks, and also with the choice of spectra included in and excluded from the table. The strong short wave-length SO_2 absorption bands near λ2,200, which are not included, ought to be included and with an asterisk; the writer knows of at least three instances where these bands have turned up very deceptively as impurities, in the absorption spectra of such diverse substances as ICl, HF and AgBr. However, the table as it stands will be exceedingly useful in identifying bands, particularly since it gives an indication of the probable intensity of occurrence of each band in each of a variety of different types of sources.

The section on "Individual Band Systems," which forms the heart of the volume, gives a very helpful survey of the spectra of each molecule listed. Selected references are given, not necessarily to the latest work, but particularly to articles containing reproductions. Methods of excitation, and classification of the electronic states involved, when known, are also given. No attempt is made to give data or references on rotational structures of bands. Multiple band heads, when present, are, however, usually listed. For most molecules, all known bands are listed; for some, only the strongest bands; in a few cases, notably the halogens, where the number of bands is large, the list is omitted. A rather casual sampling indicates that there are a number of omissions in the diatomic list. Thus, four systems of AgI and AgBr bands[1] and one system of CuCl bands[2] are unmentioned, though certain SH^+ bands published slightly later[3] in the same journal are included. (Some references up to 1940 are included.) The red system of Br_2 is not mentioned, although the reference in which it was published[4] is given. The occurrence of BiCl bands in emission,[5] and the latest work on the λ2314 C_2 band, with a photograph, are also overlooked.[6] Deuteride spectra are entirely omitted. On the other hand, a number of spectra which have not yet appeared in other compilations are listed. The Herzberg bands of O_2 and the Finkelnburg-Steiner bands (probably O_4) are described as a single system. Continuous spectra, although mentioned in some cases (*e.g.*, H_2O and Cl_2 absorption) are usually (*e.g.*, H_2 emission, F_2, HCl, ICl and BrCl absorption) omitted. The coverage of triatomic spectra, while not intended to be complete, is good. The selection of polyatomic spectra presented seems somewhat arbitrary.

Thus while one can not rely on these tables for completeness, they will be exceedingly useful, both for the identification of unknown bands and as a survey which will be stimulating for further research. The general plan and arrangement, and the text in general, are excellent. The typography and appearance of the book are very attractive.

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REPORTS

DEFENSE WORK OF THE CARNEGIE INSTITUTION OF WASHINGTON[1]

IN accordance with authorization from the trustees, the services of staff members and the use of laboratory facilities of the Institution have been made available to the government. In some cases staff members have been given leave of absence in order to enter the rolls of governmental organizations; in others, their services have been made available while they remained on salary with the Institution, working either in our own or in governmental laboratories. At the present time

[1] From the Report of the President of the Carnegie Institution, Dr. Vannevar Bush.

[1] *Phys. Rev.*, 55, 636, 1113, 1939.
[2] *Ibid.*, 54, 497, 1938.
[3] *Ibid.*, 55, 894, 1939.
[4] *Ibid.*, 38, 1179, 1931.
[5] *Ibid.*, 37, 1710, 1931.
[6] *Ibid.*, 56, 769, 1939.

eleven staff members are thus on leave, twenty others are giving full time to defense research in our own laboratories, and over forty more are devoting part time in connection with various advisory committees, as consultants to the Army and Navy, and in similar capacities. Much of the work in our own laboratories is carried on under contract with governmental agencies, the Institution being reimbursed for its added expenses in carrying out the work, but not for the regular expenses of the laboratory, the overhead or the salaries of scientists on the staff. This has allowed a greater expansion of the work than would have been possible had the Institution made the entire contribution. The heaviest burden has fallen on the Department of Terrestrial Magnetism, where nearly all the research is now on governmental problems, and the number of men in that laboratory in all categories has been more than doubled in order to carry it on. The Geophysical Laboratory, the Mount Wilson Observatory and the Nutrition Laboratory also have important efforts under way. The amount of the government funds made available for the added expenses of those programs has now reached nearly two thirds of the normal budget of the Institution.

This type of work is now being done in scientific laboratories all over the country; it was concentrated at first, of necessity, in some of the larger institutions, but gradually it is reaching out to others. The whole program is being enlarged to meet increased needs, especially in the field of medical research.

In order that the combined effort may be properly integrated, the President of the United States has, by Executive Order, created the Office of Scientific Research and Development as a part of the Office for Emergency Management, and has given this Office the task of coordinating all defense research, and, through its subordinate bodies, of supplementing the research of the Army and Navy in the development of instrumentalities of warfare and in medical research connected with defense. The president of the Institution is director of this office, and many staff members are members of its organization. Its main offices are located in the Administration Building of the Institution, under an arrangement whereby space, furnished at first to the government at nominal cost, is now made available for government purposes without charge. The chairman of the National Defense Research Committee, which is a part of the office, is now President James B. Conant, of Harvard University, and the chairman of its Committee on Medical Research is Dr. A. Newton Richards, of the University of Pennsylvania. The office has close relations with all governmental agencies and private organizations concerned with defense research. It has especially close relations with the National Academy of Sciences, which is the advisory body to all governmental agencies on their scientific programs, and of which our fellow trustee, Dr. Frank B. Jewett, is president; and with the National Research Council, with which many of our staff are associated, the important Medical Division being headed by Dr. Lewis H. Weed, of the Board of Trustees.

Many of the dislocations and stresses produced by the emergency are not pleasant. There is, however, one decidedly pleasant aspect of the matter. Owing to the close connection of the Institution with the defense research effort there is a continual succession of visits to the headquarters of the Institution from the outstanding scientists of the country, from members of our own staff from a distance, and from the many trustees of the Institution who are concerned with various aspects of the defense problem. When the emergency is over the scientists of the country will be better acquainted with one another, and they will also be better acquainted with the Institution. This should certainly be of a real benefit when our full normal program again occupies our laboratories, and when our aid and collaboration again become fully extended to those in other institutions whose research is closely allied to our own.

SPECIAL ARTICLES

A BASIC MECHANISM IN THE BIOLOGICAL EFFECTS OF TEMPERATURE, PRESSURE AND NARCOTICS

AN important property of isolated proteins and enzymes, heretofore not adequately recognized in studies on living systems, is that of reversible denaturation. Active native trypsin has been shown to exist in equilibrium with an inactive, denatured form.[1] The equilibrium may be influenced in diverse ways, *e.g.*, temperature, acid, alkali, alcohol. Evidence that such a reversible denaturation (RD) might be of major importance in controlling the intensity of bacterial luminescence led us to undertake a re-evaluation of certain factors—temperature, pressure and narcotics—in biological systems.

For this problem the luminescence of bacteria is ideally suited. Under given conditions, the intensity of luminescence is proportional to the reaction velocity of the light-emitting enzyme, luciferase. Luminescence thus provides a unique and instantaneous measure of enzyme action within the living cell.

The influence of temperature on the luminescence

[1] M. L. Anson and A. E. Mirsky, *Jour. Gen. Physiol.*, 17: 393, 1934.

intensity of two unrelated species of bacteria is shown in Fig. 1. *Photobacterium phosphoreum* is a marine,

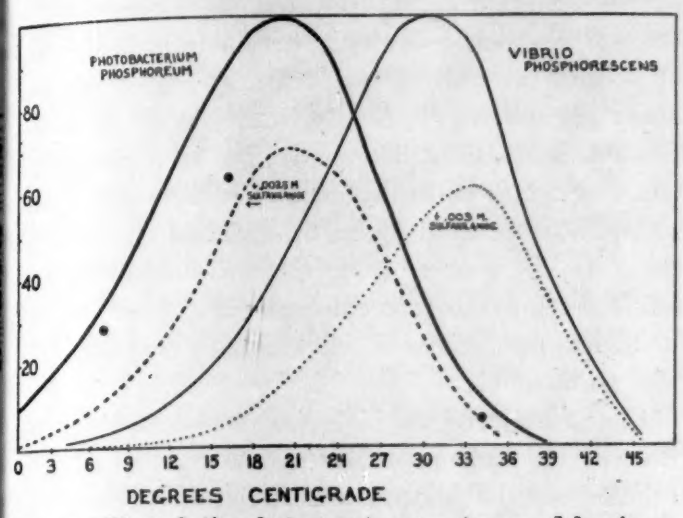


FIG. 1. The relation between temperature and luminescence intensity in suspensions of two, unrelated species of luminous bacteria, *Photobacterium phosphoreum*, (heavy line) and *Vibrio phosphorescens* (lighter line). The lines represent smoothed curves through a multitude of experimental points. The effects of moderately inhibitory concentrations of sulfanilamide are represented by the dotted lines. The solid points indicate the reversibility of heat diminution of luminescence intensity of *P. phosphoreum* when a normal suspenson is quickly warmed to 34° C., cooled at once to 16° and then to 7° C.

psychrophilic coccus, while *Vibrio phosphorescens* is a fresh-water, mesophilic vibrio. The essential similarity between the curves is quite apparent. The important difference is that each species has its own particular position on the temperature scale, with optimum temperatures of approximately 20° and 30°, respectively. These data clearly indicate that any factor whose influence on luminescence is affected by temperature, whether a chemical factor such as sulfanilamide (see Fig. 1)* or a physical agent (see below), must be considered in relation to the temperature characteristics of the particular species involved. Only in this way can one expect to obtain comparable results, whatever the species, or its particular range of temperature.

In regard to the temperature-intensity curves, the basic observation is that the decline in intensity above the optimum is almost entirely reversible on cooling, provided the high temperature is not maintained too long. This reversibility, previously unreported except for temperatures below the optimum, shows that neither a thermal destruction of the enzyme nor a killing of the cells is responsible for the decrease in luminescence intensity. The reversible reaction, however, does have a high temperature coefficient. The μ value of about 55,000 calories approaches the 67,600 calories reported by Anson and Mirsky[1] for the heat of reaction in the equilibrium between active native and inactive denatured trypsin. Other protein denaturations possessing temperature characteristics of the same order have been considered in relation to the theory of absolute reaction rates by Eyring and Stearn.[2] These facts strongly suggest that the decrease in luminescence intensity at higher temperatures is caused by a reversible denaturation of the enzyme, in this instance, luciferase (Harvey).[3,4]

The real key to an understanding of the intensity-temperature relation derives from the observation that hydrostatic pressure inhibits the reversible denaturation and thereby prevents the decrease in luminescence intensity which, at atmospheric pressure, occurs at high temperatures (Fig. 2).

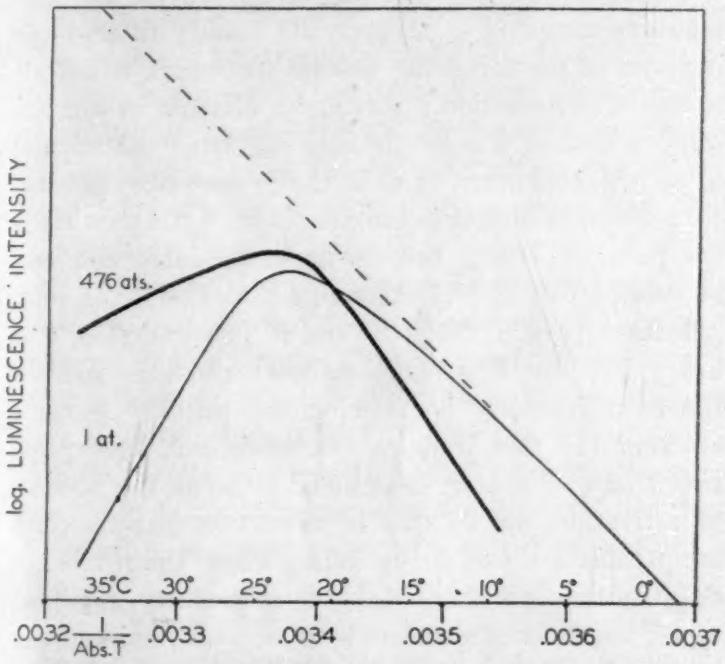
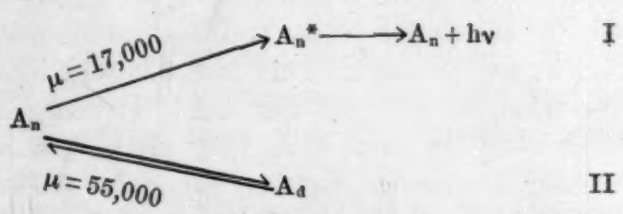


FIG. 2. The relation between temperature and luminescence at atmospheric and 476 atmospheres pressure. The extrapolated broken line shows luminescence when corrected for the reversible denaturation.

On the basis of these results, the control of luminescence may be diagrammed as follows:



wherein native luciferase, A_n, becomes excited to A_n^* in an oxidative reaction, and then emits light in a reaction independent of temperature. The oxidative

* The sulfanilamide studies have been aided, in part, by a grant to one of us (F. H. J.) from the Penrose Fund of the American Philosophical Society.

[2] H. Eyring and A. E. Stearn, *Chem. Rev.*, 24: 253, 1939.
[3] E. N. Harvey, *Erg. d. Enzymfors.*, 4: 365, 1935.
[4] E. N. Harvey, *Ann. Rev. Biochem.*, 10: 531, 1941.

reaction (I) has an energy of activation of about 17,000 calories. The amount of active, native luciferase, however, depends on the equilibrium (II) between the native and denatured forms. This equilibrium, the reversible denaturation, has a heat of reaction of about 55,000 calories. Thus, at any temperature the actual light intensity is the net result of two simultaneous reactions: (I), the primary enzyme reaction, leading to light emission, and (II), an equilibrium governing the amount of active enzyme. At temperatures low with respect to the optimum, (I) predominates and (II) is negligible. At the relatively high temperatures, (II) predominates. At either extremity, the temperature-intensity curve (Fig. 2) is practically a straight line. At the optimum, (I) and (II) balance.

The action of pressure throughout all of the temperature range (Fig. 2) may be readily interpreted in terms of the foregoing scheme. Pressure is known to retard any reaction involving an increase in volume, such as that of a molecule in going from the normal to an activated state, or as in the process of denaturation, from the initial to the final state.[5] On this basis the pressure effects become understandable and can be related to physical chemistry. At the lower temperatures (Fig. 1, below 9° for *P. phosphoreum,* and below 19° for *V. phosphorescens*) pressure reduces the light intensity by slowing the primary enzyme reaction (I) that leads to luminescence. This pressure effect, of course, is assumed to be on the process of activation, not on that of excitation directly. At temperatures above the optimum, where the reversible denaturation predominates in controlling luminescence, the effect of pressure is to increase luminescence by shifting the equilibrium (II) to the left, thereby increasing the amount of active enzyme. At the optimum temperature, pressure affects (I) and (II) to approximately the same extent, with the result that very little change in luminescence intensity is observed. It can be shown that each of these effects of pressure conforms to the Glasstone-Laidler-Eyring[5] theory of absolute reaction rates sufficiently to permit the calculation of the temperature intensity relation at any pressure. This fact, in itself, constitutes the strongest evidence that these intracellular reactions obey the same laws that govern the reaction velocity in chemical reactions generally, and it leaves little doubt as to the correctness of the interpretations and assumptions involved.

The recognition of a reversible thermal denaturation as a major factor in the temperature-velocity relation raises several points of interest. Thus, the temperature setting of the two species of bacteria may be accounted for, both in regard to the different optimum temperatures and the general form of the curves. Such differences would merely indicate that the RD reaction becomes appreciable in each species at a different critical temperature; higher for some, lower for others. Basically, such specific differences, it would seem, must be genetic; but in a given organism, any factor which would influence the RD reaction or equilibrium would tend to shift the optimum temperature, as well as to affect the absolute intensity and the temperature coefficient. There are numerous biological phenomena which might be considered from this point of view.

In the majority of biological reactions the rate or intensity of a given process agrees with the Arrhenius relation for the velocity of a chemical reaction over a limited but clearly recognizable range of temperatures. With some justification this agreement has been interpreted as evidence that the course of events is under the control of a particular chemical reaction, having a definite temperature coefficient or μ value. Deviations, prone to occur as the temperature is raised toward the optimum, have been variously interpreted. Prominent among the explanations that have been advanced is the theory of Crozier. This theory postulates that a series of consecutive reactions, each with a different temperature characteristic or μ value, is involved in any biological process. According to their μ values, different reactions in the series have been thought to become the pace-setting, or "master reaction" at different temperatures. Deviations or "breaks" in the straight-line regions of the Arrhenius plot are presumed to represent points at which different reactions in the series assume control over the velocity of the process. According to the views expressed in the present paper, however, such "breaks" would represent the point at which the RD reaction, or equilibrium, becomes significant. In contrast to the Crozier theory, this is a simultaneous reaction, involving the same molecule, rather than a consecutive member of a series of reactions. Furthermore, the RD has a high temperature coefficient, whose true value is revealed only at temperatures beyond the optimum, or by introducing another variable, namely, pressure. Indeed, from the pressure-temperature-intensity data, it can be shown that, were it not for the RD equilibrium, the logarithm of luminescence intensity plotted against $1/T$ would constitute a straight line, without a break, for a considerable range beyond the normal optimum (dotted line in Fig. 2).

Since alcohol and certain other substances are known to influence the RD equilibrium of isolated proteins it is interesting to consider the possibility that the RD reaction might be the fundamental basis

[5] Glasstone, Laidler and Eyring, "The Theory of Absolute Reaction Rates." New York: McGraw-Hill, 1941.

of narcosis by such substances in the living cell. At the optimum temperature, pressure has little effect on the luminescence intensity of normal suspensions. If this intensity is first reduced by the addition of any of a series of lipoid soluble narcotics, pressure will largely or completely abolish the inhibition. Compounds included in this group are ether, alcohol, chloroform, ethyl carbamate, phenyl carbamate and novocaine. According to the views already expressed, these substances must cause a shift in the RD equilibrium, leading to the increased volume of the denatured molecule, reversible by pressure. Another group of narcotics decreases luminescence in a manner that is not reversible by pressure, although the inhibition is largely abolished by removing the substance from the suspension medium, or in certain cases by temperature. Barbiturates, chloral hydrate, sulfanilamide and p-aminobenzoic acid belong in this latter group, which must act by a different process, perhaps a chemical or adsorptive combination with the enzyme. Members of both groups, *e.g.*, urethane and sulfanilamide, have been found to act on the enzyme, without affecting the total luminescence, of extracted *Cypridina* luciferase and purified luciferin.[6] The significant point is that pressure effects make it possible to identify the probable action of the first group, in spite of the diversity of the chemical structure, as affecting the reversible denaturation of the enzyme, and to distinguish this from the action of another large group of narcotics.

Although the foregoing discussion has been restricted primarily to bacterial luminescence, it should be emphasized that the principles developed apply equally well to the energy exchanges of muscle. Here it can also be shown that the RD reaction determines the augmentation in tension which is obtained when pressure is applied at temperatures above the optimum, whether in muscles from tropical or temperate animals. Deviations from the Arrhenius relation may be shown to depend on the interference of a reversible denaturation with a high μ value. For this reason we would expect to find the RD processes conditioning the effects of temperature, pressure and chemical agents generally. The further delimitation of this type of reaction would seem, therefore, to be of the utmost importance.

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[6] F. H. Johnson and A. M. Chase, *Jour. Cell. Comp. Physiol.*, in press.

SUCCESSFUL REARING OF A SECOND GENERATION OF MICE ON AN ARTIFICIAL DIET

IN view of the known difficulty in raising mice on highly artificial rations we offer this preliminary report of the rearing of a second generation of this species on such a diet. The basal ration, as used, consisted of Labco casein, cerulose, crisco, Osborne and Mendel salt mixture with added zinc carbonate, agar, wheat germ oil and 3 per cent. rice polish filtrate factor II. This basal mixture was supplemented with cod liver oil concentrate, thiamine, riboflavin, pyridoxine, nicotinic acid, calcium pantothenate, choline, para-amino benzoic acid and inositol.[1] During the past month, linoleic acid has been added. The actual proportions of components used in the above diet (Diet A–2) as worked out by McElroy will be published later.

A group of 14 strain C_{57} black mice,[2] 5 males and 9 females, were placed on Diet A–2 at weaning. Of these 14, all 5 males and all but 2 of the females are alive and well after 184 days of subsistence on this diet. Growth curves of the whole group and their descendants in addition to the history of 10 of the original animals will be reported later, as not all the females were allowed to mate as soon as they were mature. Three females (Nos. 9, 8 and 12) were mated with a sibling male initially. To date female 9 has had 3 litters with a total of 10 live and 4 dead young. She did not lactate until the third litter was born on the 157th day of subsistence on the diet. Of this third litter of 4, she has successfully raised to weaning 3 young.

As a result of the first mating females 8 and 12 had litters totalling 10 live and 1 dead young on the 55th day on the diet. Both females lactated and 8 of the young (f_1) were raised to weaning and placed on Diet A–2; one young male died subsequently from an accident. At 69 days of age the 4 young females (f_1) were allowed to mate with two male siblings. All these females became pregnant readily, but one died of peritonitis 9 days after a vaginal plug was found. When 91 days of age, the 3 remaining females had litters totalling 16 live and no dead young. One of the young from each litter died during the first day of life. Although these were first litters, all three mothers lactated. Lactation gradually ceased in 1 mother and her 3 young were dead by the 13th day. The other 2 mothers reared their litters of 4 and 6 young successfully to weaning at 21 days of age. These 10 second generation (f_2) mice are now alive and growing well on Diet A–2 at 41 days of age.

The two original females (Nos. 8 and 12) have

[1] We are indebted to Merck and Company for supplying in pure form the various members of the vitamin B complex used in these experiments.

[2] Supplied by Dr. L. C. Strong.

successfully reared second litters, weaning 9 out of 11 young born alive on the 135th day of subsistence of these mothers on Diet A–2. Obviously the stock diet fed to these mice (Nos. 8 and 12) prior to the start of the feeding experiment in which Diet A–2 has been used, can not be regarded as playing a role in determining the success in reproduction and lactation of these mice with their second litters.

It is interesting to note, in reporting our success with the C_{57} mice, that there may be a strain difference in mice as regards reproduction and even continued maintenance of life on artificial diets, since attempts to duplicate our results using Diet A–2 and a different strain of mice have been unsuccessful to date.

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FERTILE TETRAPLOIDS OF SESAME, SESAMUM INDICUM LOEW, INDUCED BY COLCHICINE

Sesamum indicum Loew is a plant of the family Pedaliaceae which originated in tropical Asia and has been cultivated since ancient times for the high quality oil of its seeds. Although it has been used in all the tropical and subtropical countries for so many years, it is known only in its diploid form of 26 chromosomes.

In September, 1940, the axillary buds of some sesame plants were treated with 0.5 per cent. colchicine in lanolin and others with 0.4 per cent. colchicine emulsion.[1] With either of the two preparations severe burning and dying back of the leaves occurred, followed by the formation of callus-like tissues and new buds.

When new branches developed the four-celled mucilage-producing glands of the leaves were larger on some than on others. Leaves with larger glands had correspondingly larger but fewer stomata than those with smaller glands. Chromosome counts in the pollen mother cells of the branches with large glands revealed that a few of them had the tetraploid number, 52, while others had between 26 and 52. Some of the branches with 52 chromosomes were fertile. It is highly probable that if only a small number of plants had been treated with colchicine, no fertile branches would have been obtained.

Most of the normal branches were severed, but a few were left to furnish material for a direct comparison between fertile tetraploids and diploids on the same plant. The data in Tables 1 and 2 were obtained from 20 of these plants.

TABLE 1

Type of branch	Number of glands per cm² of leaf area	Size of glands	Total volume of glands per cm² of leaf area
	per cent.	per cent.	per cent.
Diploid ...	100	100	100
Tetraploid.	68	264	180

TABLE 2

Variety	Type of branch	Average number of seeds per pod	Average weight of 1,000 seeds	Average weight of seeds per pod	Comparative weight of seeds per pod
			grams	grams	per cent.
Jaffa	Diploid	91	3.41	0.310	100
	Tetraploid	90	5.04	0.454	146
Colombiano	Diploid	58	2.60	0.151	100
	Tetraploid	55	4.23	0.233	154
Criollo	Diploid	55	2.56	0.141	100
	Tetraploid	56	4.12	0.231	164
Selection 3	Diploid	53	2.58	0.137	100
	Tetraploid	52	4.19	0.218	159

The average increase in size of seeds obtained by doubling the chromosome number was 56 per cent. There was no reduction in the number of seeds per pod nor in the number of pods per branch.

By subsequent colchicine treatment, hybridization and selection, haploids, diploids, triploids, tetraploids, hexaploids and octoploids have been obtained. Field tests of the comparative seed yields, quantity of mucilage, and per cent. of oil of the various types have not yet been completed.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODEL GEYSER

GEYSERS, which are special types of hot springs that gush or erupt into the atmosphere at various intervals, are one of the most intriguing of natural phenomena and have held the interest of geologists and laymen alike for many years. As a result of this interest, many theories and modifications have been presented to explain the cause and manner of the eruptions. In addition, there have been a number of experimental geysers constructed throughout the last 100 years,

[3] The expenses of this investigation were defrayed in part by a grant to G. R. C. from the Research Fund of the Yale University School of Medicine.

[1] Prepared by L. F. Randolph, of the Department of Botany, Cornell University, and Division of Cereal Crops and Diseases, Bureau of Plant Industry, Washington, D. C.

more or less. Some models have worked directly on, or upon some modification of, the most widely accepted geyser principles, whereas others have been merely jets of water or steam thrown into the air at intervals by some foreign influence.

Allen and Day[1] recently studied the hot springs, including geysers, of Yellowstone National Park and have not only presented some interesting new facts, but have also entered into a thorough discussion of older theories and observations. The reader is referred to their work for a concise discussion of geyser principles and occurrences.

In general, the recognized requirements for continued geyser action are: (1) A subterranean chamber connected by a tube vent or orifice with the surface of the ground. (2) A heat supply in excess of the surface boiling point temperature of water. (3) An intermittently replenished inflow to the heating area and tube vent of water which is cooler than boiling temperatures.

When the construction of a working model was undertaken by the authors, several disadvantageous conditions became apparent, namely, (1) specific literature and statistical data on geyser model construction are sparse and not readily available; (2) models, observed by the writers, generally were built so that they had little or no semblance to natural conditions and usually required an outside stimulus in operation or; (3) the expense and involved apparatus used in working models that did partially approach natural phenomena were prohibitive of simple and cheap construction. Proceeding on the lines, therefore, that the desired objective was a model which would simulate, as near as possible, the field characteristics of most geysers and which, at the same time, would be relatively inexpensive and easily built, the model construction herein described was undertaken.

Landscape: The landscape, which also acts as a catchment basin, and returns ejected water to the system, measures 5 feet by 5 feet in plan dimension. It was built on a 3-ply veneer wood base (salvaged packing box) to which 1-inch by 2-inch cleats were fastened on the underside for stability and for a foundation so that the sides, made of 1-inch by 4-inch boards, could be nailed securely. Three holes were drilled in the central area of the box-like structure thus formed, and into these a vent pipe (glass tube) and two glass drainage funnels were inserted. Wet excelsior, that had been soaked in a very thin mix of plaster of paris, was then placed in the box and was shaped into the desired topography. This, in turn, was covered by wet burlap cloths and over the cloths a heavy, thick plaster of paris coating was applied and smoothed out to conform with the previously formed relief. Care was taken to insure that the drainage funnels were at the lowest elevations of the landscape and that the geyser orifice was relatively high.

After the plaster had set for 24 hours, the first of a series of 6 coats of shellac were applied to the modeled surface. Possibly it was not necessary to apply this number of shellac thicknesses, but, in so doing, a sufficiently tough skin was developed to withstand continual drenching by the hot waters for a period of 14 hours without appreciably softening the underlying plaster.

Inasmuch as all other necessary details of the construction and geyser set-up are shown on the accompanying sketch (Fig. 1), they are not repeated here.

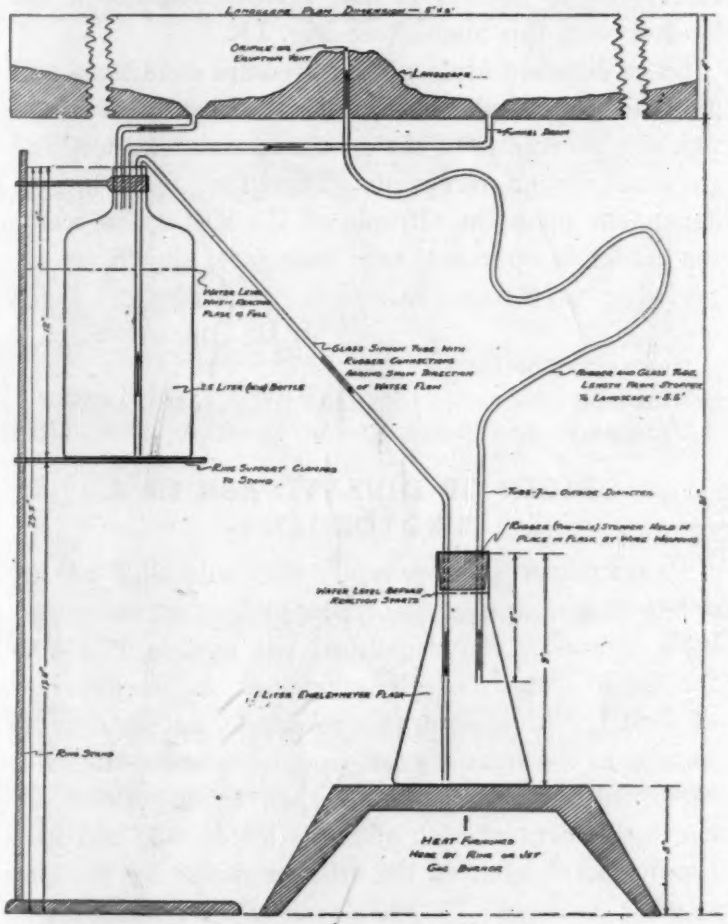
Landscape
Funnel Drain
Glass Siphon Tube with Rubber Connections
2.5 Liter (qt.) Bottle
Rubber and Glass Tube
Rubber Stopper Held in Place in Flask by Wire Hooking
Water Level Behind Ebullition Stopper
1 Liter Erlenmeyer Flask
Ring Stand
Heat Furnished Here by Ring or Jet Gas Burner

FIG. 1. A model geyser.

When the geyser is "playing," hot water and steam are ejected every 1.5 minutes approximately to a maximum height of 3.5 feet. The period between eruptions varies slightly with the temperature of the water system. When the circuit becomes heated to a uniform temperature through the continued return of warm water which has been ejected, the eruption period becomes stabilized. 15–20 cc of water must be added to the system about every hour in order to replace that which has been discharged and lost as steam. The new water is introduced by simply pouring it out over the landscape where it enters the circuit through the drain funnels.

[1] E. T. Allen and Arthur L. Day, Publication No. 466, Carnegie Institution of Washington, pp. 171–231, 1935.

Delicate adjustments of conditions must be established for satisfactory operation of the model, but fortunately they can be made readily and with ease as the equipment is being put into operation. For instance, the height of the reservoir above the heating chamber and the heat applied are variables that must be controlled. That is, under a given heat constant the reservoir can not be too high or proper siphoning action will not develop and continual steaming of the heating chamber will result. Conversely, if the reservoir is too low there may not be enough back pressure to cause an eruption through the orifice and a bubbling back into the reserve water may ensue. The adjustments can be made by raising or lowering the ring stand, or the heat may be increased or lessened, or both reservoir height and heat may be varied. The reservoir can not, of course, be elevated above the landscape in this model (see Fig. 1).

Since different atmospheric pressure conditions will govern the particular interrelations of heat, water supply, etc., no studies of the operating temperatures and gas consumption were made. These factors are largely dependent upon the altitude of the locality in which the model is operated, and, therefore, should be expected to vary somewhat.

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ORIGIN OF DIPEPTIDASE IN A PROTOZOAN

PARAMECIUM is apparently the sole diet of the ciliate *Didinium nasutum*. Dipeptidase extracts from both organisms show identical pH optima (7.4–7.6) for the hydrolysis of alanylglycine. When deprived of food Didinium continues to divide, but there is no change in the quantity of dipeptidase present. For example, a parent Didinium has exactly twice the enzyme content of each of its daughter cells and four times that of each of the cells produced by the succeeding division. *Paramecium multimicronucleatum*, which is somewhat larger than the largest Didinium, is entirely ingested by Didinium in about one minute. Immediately after ingestion a single large food vacuole is present in the Didinium and this vacuole divides into a large number of small ones in about twenty minutes. Morphological changes indicating digestion of the Paramecium occur rapidly.

High values for the dipeptidase content of *P. multimicronucleatum* were obtained by the addition of liberal quantities of dried brewer's yeast to a previously boiled hay infusion. The enzyme content of single individuals of *P. multimicronucleatum* was readily determined, but marked variations between individuals are usual. Thus, individual variations in physiological condition as well as in size make the selection of quantitatively uniform individuals infeasible.[1] Greater uniformity could be obtained with genetically pure strains of *P. aurelia* supplied by T. Sonneborn, but the enzyme content of these was too low for this work.

When single didinia were fed single paramecia and left for various time intervals up to four hours, the enzyme content was consistently found to equal the sum of that of predator plus prey within the range of individual variation of the paramecia (the enzyme content of the didinia can be predicted precisely). The dipeptidase content of groups of twenty-five organisms from single cultures of each species is quite constant. When twenty-five *Paramecium multimicronucleatum* were added to a drop containing twenty-five hungry didinia, the paramecia were all eaten in about one half hour, some didinia eating two and some none. When such didinia were left for four hours and the dipeptidase content then determined, it was found that the enzyme content was equal to that of the original didinia plus that of the ingested paramecia. Uniform extraction of the dipeptidase and sterility of the extract was obtained by repeated freezing and thawing with dry ice. This procedure does not impair the dipeptidase activity. It is to be borne in mind that the methods employed show the enzyme content of the cells and do not indicate the intracellular enzyme activity. In view of the digestion time allowed (about the duration of one cell-generation) one may conclude either that Didinium dipeptidase is synthesized at exactly the same rate that paramecium dipeptidase is being destroyed or else, and more probably, that paramecium dipeptidase is taken over quantitatively by Didinium.

WM. L. DOYLE

ELIZABETH K. PATTERSON

BRYN MAWR COLLEGE

[1] H. Holter and W. Doyle, *Jour. Cell. Comp. Physiol.*, 12: 295–308, 1938.

BOOKS RECEIVED

BLIVEN, BRUCE. *The Men Who Make the Future.* Pp. xiii + 325. Duell, Sloan and Pearce. $3.00.

DUFF, A. WILMER and MORTON MASIUS. *College Physics.* Pp. x + 588. Longmans, Green. $3.80.

PEASE, ROBERT N. *Equilibrium and Kinetics of Gas Reactions.* Pp. ix + 236. Princeton University Press. $3.75.

RIDER, JOHN F. *Automatic Record Changers and Recorders.* Illustrated. Pp. 723. Rider. $6.00.

SHAFFER, LAURANCE F., B. VON HALLER GILMER and JAMES M. PORTER, JR. *Experiments and Demonstrations in Psychology.* Pp. xi + 230. Harper. $2.50.

Studies in the History of Culture. American Council of Learned Societies. 24 papers from member societies. Pp. xxiii + 343. George Banta.

SYNGE, J. L. and B. A. GRIFFITH. *Principles of Mechanics.* Pp. xii + 514. McGraw-Hill. $4.50.

VAN LIERE, EDWARD J. *Anoxia, Its Effect on the Body.* Pp. xiii + 269. University of Chicago Press. $3.00.

Recent Texts in Physics

PRINCIPLES OF MECHANICS

By J. L. SYNGE and B. A. GRIFFITH, University of Toronto. 514 pages, 6 x 9. $4.50

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SCIENCE NEWS

Science Service, Washington, D. C.

ASTRONOMICAL WORK AT MOUNT WILSON

DISCOVERY of an intensely hot star surrounded by a luminous ring of gas four times the diameter of our sun is announced by A. H. Joy, of the Mount Wilson Observatory, from results obtained with the 100-inch reflector.

Viewed from a distance of a billion miles the star would resemble the planet Saturn as seen through a small telescope. The ring is revolving around the star at a speed of 800,000 miles per hour, completing a revolution every 14 hours.

The star is one member of the double star system RW Tauri. The other member is about twice as large with a surface temperature of 11,000 degrees Fahrenheit, or nearly the same as our sun. The large star revolves around its ringed companion once in 66 hours. Evidence for the existence of the ring was obtained from a study of the light variations of the system when the larger star eclipsed the smaller. The ring was found to be composed of glowing gases of hydrogen, magnesium, calcium, and iron.

"Observations are difficult on account of the faintness of the stars," Mr. Joy stated, "but it seems probable that by taking photographic exposures properly timed both the distribution of the chemical elements as well as the light intensity in the ring may be determined."

What was supposed to be an old "new" star or nova that had been abandoned for lack of interest by astronomers for nearly twenty years, has turned out to be actually a variable star of a type previously unknown. The discovery was also reported to the Astronomical Society of the Pacific by Mr. Joy.

Mr. Joy said that the star was put on the program of the 100-inch reflector because in the past it had shown sudden changes in brightness which indicated it might prove to be a recurring nova. But when the telescope was pointed at the object two so-called red dwarf stars were found there instead. Later Dr. A. van Maanen, also of the Mount Wilson Observatory, secured photographs which confirmed the identification. What was still more surprising was the detection of bright clouds of hydrogen and calcium gas in the atmospheres of stars of such low temperature.

"Further observations will be needed to determine whether the observed variations in light pertain to both stars of the pair," Mr. Joy stated. "These observations indicate that certain small low-temperature stars show changes in brightness not fully recognized before."

A remnant of what was probably one of the brightest "temporary" stars on record—the famous nova observed by Kepler in 1604—has been discovered by Dr. Walter Baade, of the Mount Wilson Observatory. The object is very close to the position given by Kepler and resembles a small fan-shaped cloud. It is clearly visible on photographs taken in red light but very faint on the ordinary plates sensitive only to blue light. This probably explains why repeated attempts in the past to locate the star have failed. The star suddenly blazed out in 1604 and for several weeks was as bright as the planet Jupiter. For nearly two years it was studied by the great astronomer, Kepler, until it faded from sight. Although Kepler left careful records of the star's position and brightness, repeated search centuries later with the most powerful telescopes failed to locate the object. Kepler's nova is of extraordinary interest in that it was undoubtedly a supernova, a type of nova far brighter than the ordinary temporary stars. It is believed to have been the third supernova to appear in our galactic system in the last 900 years.

A POSSIBLE EPIDEMIC OF MENINGITIS

WARNING that an epidemic of meningitis, also called cerebrospinal fever, may occur in this country in "the near future" appears in the current issue of *War Medicine*, published by the American Medical Association in cooperation with the National Research Council.

No evidence of an epidemic now or in the immediate future appears in the weekly reports to the U. S. Public Health Service. The latest figures available, for the week ending January 31, showed a total of sixty-five cases of meningitis scattered throughout the entire nation with no concentration in any one place to suggest an epidemic brewing. The total number of cases is slightly above the five-year median of fifty-five cases.

The Federal Health Service, however, points out, as do Dr. John H. Dingle and Dr. Maxwell Finland, of Boston, in their report to *War Medicine*, that conditions are favorable for an outbreak of meningitis. The cold weather, still prevalent in most parts of the country, which keeps people indoors in close association with each other favors the spread of this disease.

"An outstanding feature of the disease has been its occurrence during wartimes in epidemics involving both military and civilian populations. During World War I there were 5,839 cases of meningococcic meningitis in the United States Army, with 2,279 deaths, a case mortality rate of 39 per cent. Although the attack rate and the military non-effectiveness rate have usually been low, the sudden way in which the disease strikes, its mysterious manner of spread and its high mortality may have a serious effect on the morale of civilian and military personnel.

"These features, the unprecedented incidence of the disease in England since the outbreak of the present conflict—a total of 12,500 cases occurred during 1940—and its occurrence on this continent in Nova Scotia all point to the possibility that this country may be confronted with outbreaks of this disease in the near future."

It is pointed out that the sulfa drugs have improved the outlook in this disease considerably, and "may offer a useful prophylactic measure in the prevention of its epidemic spread."

SHARKS ON THE PACIFIC COAST

SAVE the sharks! Such is the strange new conservation cry raised by commercial fishermen of the Pacific Coast.

It's all because of vitamins, Dr. Lewis Radcliffe, vice-president of the Izaak Walton League of America, explained speaking before a group of wildlife executives in Washington. During the past couple of years, the high vitamin value of the liver oil in certain shark species has been discovered. The soup-fin shark, once sought as a source of an exotic Chinese delicacy, is especially prized. Its liver oil is bracketed along with codliver and halibut liver oils for highest vitamin potency. However, other shark livers have their value. Even the humble but abundant dogfish shark yields a liver oil of at least moderate vitamin value.

Shark liver oil is especially sought for during the present war emergency, not so much because more vitamin pills are needed in this country, but because it is very much in demand for lend-lease shipment to Britain, for the enrichment of margarine. Lower grade shark liver oils are also of use here, to heighten the vitamin values of stock feed, especially for dairy cattle and chickens.

All this has resulted in the sudden growth of a shark fishing industry on the West Coast. It used to be that if a fisherman chanced to pull in a shark of any kind, he would angrily chop off its tail, to make it bleed to death quickly, and kick the despised carcass back into the ocean. Now he carefully saves the liver. As recently as 1938, government reports did not give a separate listing to shark liver oil. In 1940, the catch amounted to 223,000 gallons, valued at $1,125,000.

Shark liver oil has higher vitamin potency at some seasons than at others. In the soup-fin shark, for example, it is lowest during summer, when the young sharks are being born. Hence, the present demand for protection of the shark fisheries includes also a call for restriction of the fishing season to the times when the liver oil has its highest natural vitamin potency.—FRANK THONE.

STABLE FLIES

HORDES of flying enemies that threatened the success of the new aviation training program along the northwestern Gulf coast of Florida have been defeated in a joint chemical warfare campaign conducted by the U. S. Department of Agriculture and the U. S. Public Health Service. Benefitted also were the civilian population of the region and the long-suffering Florida cattle.

The enemies were uncountable myriads of biting flies, known locally as dog flies. They were the same species known as stable flies elsewhere—insects that look very much like common house flies, but armed with fierce little dagger-like mouthparts that make life miserable for man and beast.

These flies have long been intolerable pests to human beings, and sometimes a cause of loss among cattle. The poor beasts flee into swamps to escape their bites, become bogged down and perish. However, when they began seriously to interfere with the aviation training program, prompt action was called for.

When Dr. W. E. Dove, of the Bureau of Entomology and Plant Quarantine, with headquarters at Panama City, Fla., moved into the field, the first thing he sought was the places where they bred. He found this to be the great windrows of fermenting aquatic vegetation cast up on the shores of bayous and backwaters reaching inland from the coastal sandbars.

Sprays of arsenical insecticides were found to be effective, but the most practicable and economical means of attack proved to be creosote oil, diluted in a light diesel fuel oil. Attack was delivered from barges operating in the shallow inshore waters, each barge carrying a power sprayer and lines of hose with nozzles. Colored day laborers formed most of the crews. A single application was found to be completely effective against larvae and eggs already in the fermenting masses. It also discouraged adult flies from returning to deposit more eggs. Residents of the region reported that they had never enjoyed a season so nearly completely free of dog flies, and the flying cadets could concentrate on learning the business of winged warfare.

There is a different kind of dog-fly plague inland in the South, Dr. Dove states. Here the insects breed in heaps of decaying leaf-trash left in peanut fields after the nuts and peanut hay have been harvested. Remedy for this situation is simple, and can be left to the farmers. All they need to do is scatter the trash heaps and plow them under.—FRANK THONE.

THE PERUVIAN FLAX INDUSTRY

PERU is enjoying a war-born boom in flax, a new crop for the South American republic. Starting with an experimental hundred acres or so only three years ago, Peruvian planters jumped the acreage to 35,000 for the crop now being prepared for market. Most of Peru's flax will be bought in this country, partly replacing the European imports cut off by the war.

A survey of the new Peruvian flax industry has been brought back to the U. S. Department of Agriculture by Dr. B. B. Robinson, of the Bureau of Plant Industry, who has returned from a tour of the West Coast countries of South America, as a member of a scientific mission studying plant resources of possible use in the joint defense efforts of the Americas.

Dr. Robinson states that Peru seems to be exceedingly well adapted for the raising of flax. Constant sunshine over rich soil, with plenty of water for irrigation leaves the planter nothing to wish for. Flax responds by growing tremendously—six-foot stalks are not at all uncommon.

Techniques for harvesting and handling the flax are still crude, but experience is already indicating the way to improvements, with increased use of machinery. Present scarcity makes it advisable to produce all the flax possible, without waiting for the development of better methods. In fact, Dr. Robinson states, there is a tendency to go through the typical boom-crop cycle and plant as great an acreage as can be seeded, regardless of the prospect of collapse that may occur in post-war readjustment days when the return of European flax sources to the market, together with other factors, can be expected to cause a steep drop in prices.

A curious archeological discovery was made on one

large hacienda, in the course of digging a retting pit for the flax. (Flax is processed by retting, or soaking in water for two or three weeks, to permit the connective tissues of the stalk to decay and free the fiber.) Several feet under ground, a big copper tank, nine feet long, three feet wide and three feet high, bearing a sixteenth-century date, was found. Some years ago, another big copper tank shaped like a soup bowl was found in the same neighborhood. Nobody knows what they were used for.

Elsewhere in his travels, Dr. Robinson studied the growing of hemp in Chile and the harvesting of kapok in Ecuador. Chilean hemp has always had its principal market in England, but some of the crop will now be sent to this country. Regrettably the 1941 crop of kapok, the lighter-than-thistledown fluff used in life-preservers and pillows, was an almost total failure, due to unfavorable weather when the trees were in blossom.

GAME HERDS OF NEWFOUNDLAND

THE Newfoundland Department of Natural Resources has recently completed a survey of their Virginia-sized island with the thought of increasing the game and meat supply by introducing either American white-tail or English red deer. By some incredible accident of geography this oldest of English colonies was never populated with the same numerous big game species as was near-by Canada and the United States. Only the black bear and woodland caribou are native to Newfoundland.

Some years ago moose were brought from the mainland and released on the island paradise. Since then they have become established and reproduced to the point where some hunting is possible. Moose and caribou, however, are animals that prefer to remain as far away from human habitation as possible, and it is doubtful that they will ever populate the parts of the island occupied by scattered farms.

Deer, on the other hand, are quite agreeable to living in close proximity to human habitation. It is the thought of game officials that they can perform a dual function by introducing deer. Not only will they be increasing the game supply but they will also be alleviating the fresh meat scarcity in farming communities. At the same time they will be introducing an animal that will merely occupy a place heretofore vacant, an animal that will not compete in food or territory with the moose or caribou.

ITEMS

THE fact that the epidemic of eye disease reported among West Coast shipyard workers is limited to one class of workers, specifically welders, makes it unlikely that it is a germ disease spread by saboteurs. If the disease were due to germs, it would almost certainly spread to other workers and to the families of the welders. There is no infectious, or germ-caused disease peculiar to welders.

ALL air force personnel in Canada and Newfoundland are being tested with the Schick and Dick test for susceptibility to diphtheria and scarlet fever. Those found susceptible are being given injections of diphtheria toxoid and scarlet fever toxin. That more than 50 per cent. of the personnel are susceptible to diphtheria on entering the service, is reported by Flight Lieutenant A. H. Sellers, R.C.A.F. Medical Branch, in the *Canadian Medical Association Journal*. The number susceptible to scarlet fever exceeds 25 per cent. on the average. "The health of the personnel of the British Commonwealth Air Training Plan has continued to be maintained at a high level, but outbreaks of diphtheria and scarlet fever during the winter and spring of 1940–41 caused sufficient sickness and loss of time to justify the introduction of procedures promising an effective measure of future control."

A TWENTY-YEAR-OLD youth whose heart ceased to beat for 20 minutes while he lay on an operating table completely recovered partly because of heroic surgical teamwork, partly for reasons not understandable. His heart was forced to continue its motion artificially by the rhythmic contractions of the surgeon's hand placed directly on the paralyzed organ. Described by surgeons as "almost unheard of" this case is reported in the *Journal* of the American Medical Association, by Drs. Herbert D. Adams and Leo V. Hand, of Lahey Clinic, Boston. The patient's heart stopped two hours after anesthesia had begun during a chest operation. Immediately the surgeon began the artificial contractions of the heart with his hand, while stimulants were injected into the heart muscle and artificial respiration maintained. At one time the heart stirred naturally, beat five or six times, then ceased. Finally it began its natural beat, this time permanently. Normally death comes from 7 to 10 minutes after the heart stops. In this case these brain centers were kept alive by lowering the patient's head to aid blood flow, artificial respiration and circulation. Drs. Adams and Hand comment: "This case demonstrates that the time interval of cardiac arrest compatible with normal recovery is much longer than formerly appreciated."

WORN machine parts, such as shafts, bearings, hinge pins, pistons and the like, can be built up to their original dimensions at one third to one half the cost of new parts and in some cases with wearing qualities superior to the original, was stated by W. J. Cumming, automotive engineer of the Surface Transportation Corporation, at the Detroit meeting of the Society of Automotive Engineers. The building up is done by spraying the worn part with a fine mist of molten metal blown from a gun. The piece is first prepared by roughening its surface by sand blasting or other means according to the nature of the metal. This insures interlocking or dovetailing of the new metal to the old. The built-up piece is then machined or ground to the proper size and quality of surface. The wearing qualities of the built-up piece can be made superior to the old by coating it with a harder metal. This can also be done with new pieces, Mr. Cumming stated. This would effect an economy of the hard metals.